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Year

G B Airy

The Astronomer Royal.

THE

YEAR-BOOK OF FACTS

IN

Science and Art:

1854

EXHIBITING

THE MOST IMPORTANT DISCOVERIES & IMPROVEMENTS OF THE PAST YEAR;

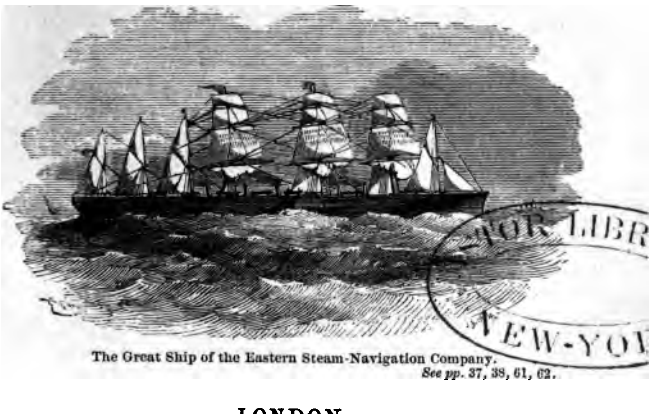
IN MECHANICS AND THE USEFUL ARTS; NATURAL PHILOSOPHY; ELECTRICITY; CHEMISTRY; ZOOLOGY AND BOTANY; GEOLOGY AND GEOGRAPHY; METEOROLOGY AND ASTRONOMY.

BY JOHN TIMBS, F.S.A.,

EDITOR OF "THE ARCANA OF SCIENCE AND ART," AND AUTHOR OF "CURIOSITIES OF LONDON."

"The power would have availed little, if the possessors of it had not been willing to allow it to be used for the benefit of society."—PROFESSOR AIRY.

"The real stimulant to science has at all times been the delights of the pursuit itself, and the consciousness of the great services rendered to humanity by every conquest within the domain of truth."—THE EARL OF HARROWBY, *President of the* BRITISH ASSOCIATION, 1854



The Great Ship of the Eastern Steam-Navigation Company.
See pp. 37, 38, 61, 62.

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THE ASTRONOMER ROYAL, PROFESSOR AIRY.

(With a Portrait.)

GEORGE BIDDELL AIRY, who fills the distinguished office of Astronomer Royal with so much benefit to science, and honour to his country, is a native of Alnwick, in Northumberland, born July 27, 1801. He was educated at private schools in Hereford and Colchester, and finally at the Grammar School in the latter town. In 1819 he commenced residence as Sizar Undergraduate of Trinity College, Cambridge; in 1822 he was elected Scholar; and in 1823 he took the University degree of Bachelor of Arts, with the honour of Senior Wrangler. He shortly after joined the Cambridge Philosophical Society, to whose *Transactions* he has contributed several valuable papers. In 1824 he was elected Fellow of Trinity College; in 1826 he took the degree of Master of Arts, and in the same year was elected Lucasian Professor. This office, rendered illustrious when filled by Barrow and Newton, had, for many years, been a sinecure; but no sooner had Professor Airy been elected, in opposition to Mr. Babbage, than he notified his intention to deliver public lectures on Experimental Philosophy. The Professor commenced this good work in 1827, and he continued the same to 1836; his system of lectures is known as the first in which (among other things) the Undulatory Theory of Light was efficiently illustrated. Professor Airy was also an active member of the then existing Board of Longitude. In 1828 he was elected, without opposition, to the Plumean Professorship, vacant by the decease of Mr. Robert Woodhouse. To the newly-elected Plumian Professor was entrusted the management of the Observatory of Cambridge, which had just been erected, and supplied with one of its instruments. The duties of this office requiring the undivided attention of Professor Airy, his income was very justly increased by annual grant from the funds of the University of Cambridge. On taking charge of the new Observatory, he vigorously commenced a course of observations; but his able services will be best remembered for the form which he introduced in the calculation and publication of the Observations, by which their utility was very greatly increased: it has served as a pattern for the forms adopted at Cambridge. Greenwich, and other Observatories, to the present time. Professor Airy had also the satisfaction of superintending the mounting of the Equatorial, the Mural Circle, and the Northumberland Telescope (the last entirely from his own plans), at the Cambridge Observatory.

In the autumn of 1835, the office of Astronomer Royal became vacant by the resignation of Mr. John Pond, when Mr. Airy was appointed to it. The patronage of this office rests with the first Lord of the Treasury; but the selection was made in this instance by Lord Auckland, then first Lord of the Admiralty. In the discharge of his duties, Mr. Airy has distinguished himself by giving great regularity to the general proceedings in the Greenwich Observatory; by maintaining with great steadiness the general outline of the plan which the requirements of a fundamental Observatory, and the historical associations, have imposed on the Royal Observatory; while he has introduced new instruments and new modes of calculation and publication, by which the value of the Observatory to science may be increased. The important introduction of the Altazimuth* and the Transit Circle (both from Mr. Airy's plans,) has undoubtedly placed the Greenwich Observatory at the head of all existing Meridional Observatories. The Magnetic and Meteorological department of the Observatory is well known for its success in the practical introduction of the system of Photographic self-registration.

Mr. Airy's Researches on Optical, Tidal, and other important scientific questions, are already well known to the readers of the *Year-Book of Facts*; and it would be difficult to point to any writer by whose labours we have so largely profited in the editorship of this work, and its predecessor, the *Arcana of Science and Art*, during the last twenty-eight years.

Among Professor Airy's contributions to science may be mentioned his masterly treatise on Gravitation, written by him for the *Penny Cyclopædia*, in 1837, and extending to 30 folio pages. To practical men, Professor Airy is known by his discovery of an efficient mode of correcting the Disturbance of the Compass in Iron-built ships: a highly important letter upon this investigation

* *A remarkably fine Engraving of this Instrument appeared in the Illustrated London News, No. 288.*

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arranged, and cleverly painted; and along the edges of the various folds is a border presenting a novel combination of the rose, shamrock, and thistle, in gold; and on the back of each fold is another device of a similar character, also in gold, with a bordering of shamrock leaf. The effect of the whole is very chaste and attractive.

THE METROPOLITAN CATTLE-MARKET, COPENHAGEN FIELDS.

THE Metropolitan Cattle-market, which has been constructed in Copenhagen-fields, Islington, under the direction of Mr. J. B. Bunning, the City Architect, is fast approaching completion. The site of the market proper is an equal sided rectangle, having a fall from the west corner to the south, east, and north corners, and includes an area of about fifteen acres, of which one acre is appropriated to the pig-market, and an equal area to the calf-market. The banking-houses, twelve in number, are placed in the centre of the market, and out of the centre of these will rise a lofty clock-tower, which is just now beginning to show itself above the roofs of the banking-houses. The Electric Telegraph Company will have a station in the building. Accommodation is provided in the market for 34,980 sheep, in 1749 pens (with a reserved space for considerable extension), and 13,232 feet of rail for the tying of 6616 bullocks. The pig and calf-markets are placed on the west side of the quadrangle, affording accommodation for 1425 calves, and 900 pigs, and raised sufficiently high to allow of the pigs and calves walking from the level of their respective standings into the carts. Roofs, supported on iron columns, and projecting so as to shelter the carts which may be standing in the road, passing from north to south, are being placed over these markets. Water-posts are fixed about twenty-seven yards apart, and by means of a leather hose and jet, will afford facilities for thoroughly cleansing the market and lairs. North of the market two taverns are erected, between which will be placed a fountain. Northward of the taverns and fountain will be a building intended for the annual cattle-show, which, when not used for that purpose, will afford ample standing for butchers' carts. West of the market, lairage is provided for 8160 sheep, on an area of 6a. 0r. 3p. rather more than half of which is covered. Water and racks for hay are placed in each lair. South of the market, lairage is provided for 3000 bullocks, on an area of 8a. 0r. 11p. provision being made for supply of water and hay to each bullock. At the north and south ends of these lairs four depôts for hay are provided. East of these lairs some private slaughter-houses are built, and on the west side two public slaughter-houses, in which 600 bullocks can be killed weekly. South of the public slaughter-houses a meat-market is being constructed. Ample space for the future extension of the public and private slaughter-houses is provided. On the south side of the New-road, a cattle-station will be formed in connexion with the North-London Railway. On the right-hand side is seen the Great Northern Railway, which there enters a tunnel. Just above this is the Hide and Skin Market. The cost of the works will be about 300,000*l.* Mr. John Wilson (Southwark) and Mr.

John Jay are the contractors for the buildings. Messrs. Kennard, of Thames-street, are executing the ironwork, of which there is an immense quantity. The corrugated iron is supplied by Mr. Walker. Mr. Chadwick is the contractor for roads and paving, to the extent of about 60,000*l.*—*Builder.*

SOAP AS A MEANS OF ART.

DR. FERGUSON BRANSON, of Sheffield, writing in the *Journal of the Society of Arts*, says:—"Several years ago, I was endeavouring to find an easy substitute for wood-engraving, or rather to find out a substance more readily cut than wood, and yet sufficiently firm to allow of a cast being taken from the surface when the design was finished, to be reproduced in type-metal, or by the electrotype process. After trying various substances, I at last hit upon one which at first promised success, viz., the very common substance called soap, but I found that much more skill than I possessed was required to cut the fine lines for surface printing. A very little experience with the material convinced me that, though it might not supply the place of wood for surface printing, it contained within itself the capability of being extensively applied to various useful and artistic processes in a manner hitherto unknown. Die-sinking is a tedious process, and no method of die-sinking that I am aware of admits of freedom of handling. A drawing may be executed with a hard point on a smooth piece of soap almost as readily, as freely, and in as short a time as an ordinary drawing with a lead pencil. Every touch thus produced is clear, sharp, and well defined. When the drawing is finished, a cast may be taken from the surface in plaster, or, better still, by pressing the soap firmly into heated gutta percha. In gutta percha several impressions may be taken without injuring the soap, so as to admit of 'proofs' being taken and corrections made—a very valuable and practical good quality in soap. It will even bear being pressed into melted sealing-wax without injury. I have never tried a sulphur mould, but I imagine an impression from the soap could easily be taken by that method." Dr. Branson has also employed bees'-wax, white wax, sealing-wax, lacs, as well as other plastic bodies; and in some of these cases a heated steel knitting needle, or point, was substituted for the ivory knitting needle. He has sent several specimens to the Society of Arts, which show that from the gutta percha or plastic cast a cast in brass may be obtained, with the impression either sunk or in relief.

DEPARTMENT OF SCIENCE AND ART.

THE first Report of the Department of Science and Art shows the results of the working of the department during the year 1853.

It appears that arrangements were completed, by which the working, progress, and cost of some of the most important public institutions, chiefly supported by Parliamentary grants, for the promotion of science and art, will be ascertained and submitted to Parliament periodically, *upon the responsibility* of a Minister of the Crown; and

that the foundation of a system has been laid by which every district and school in the United Kingdom may participate equally in the advantages which the department offers. These consist in the purchase, at a very moderate price, of models, diagrams, and apparatus for teaching; in the purchase of examples for museums; in borrowing specimens from the central museum; and in obtaining the services of teachers properly trained for any schools of science and art which each locality may think fit to establish for itself.

Summing up the actual results of the working in 1853, in the number of persons who had participated in various degrees in the benefits offered by the department, the total numbers—excluding results in Ireland, for which the data are insufficient—may be estimated at upwards of 55,000 persons.

The working of the central institution has been made subservient to the wants of the United Kingdom, and ultimately the action of the Department in the metropolis will differ from that in the provinces chiefly by having a training school for masters, and being the college for examinations. As the central museum becomes developed, it will become the depôt for similar Museums throughout the country, for the loan, purchase, and exchange of specimens. Already local schools of art enjoy the privilege of borrowing articles from the Museum of Ornamental Art, and of purchasing specimens at reduced cost. By these several means above stated, and by collecting and publishing useful experience on the subject, it may be hoped that the department will be instrumental in raising the character of our manufactures as well as the intellectual appreciation of those who have to produce and consume them.

THE ARCHITECTURAL MUSEUM

IN Cannon-row, Westminster, has been opened. It contains many hundred objects, including casts from ancient examples and from natural leaves; a number of fragments of stained glass, wood-work, encaustic tiles; seals and rubbing of brasses. In addition to these there is a large number of photographs. It is the wish of the committee to make the Museum as practically useful as possible. It is also contemplated to have a yearly exhibition of modern specimens of fine-art workmanship, thus in each successive year to show, as far as may be, the progress being made in fine-art workmanship, and in those manufactures which more particularly have relation to architecture, and also for the purpose of showing what it is that has yet to be done in the attempts now being made to rival the excellence of the old work, as to material, form, colour, &c.; the great object of the collection being to influence, as far as possible, *common* and *every-day practice.*

Copies of the different specimens in the collection are supplied, when required, to the various provincial societies, art-workmen, and others, at the cost charge.

It is proposed to add to the collection a series of the materials used *in general architectural* practice, as specimens of marbles, woods, *stones, metal, paper-hangings*, stuffs, &c.

It is desired to consider the collection as the nucleus of a complete *national collection of mediæval art* in all its branches; as being the first attempt ever made in this country to form, for the purposes of the public, such a collection. When in a more enlarged space, and a more complete state, it will, it is believed, form one of the links to complete the chain of facts gathered at the British Museum in the collection there commenced of Oriental and Greek and Roman art; and at Marlborough House, in the collection there commenced of Renaissance work.—Abridged from the *Builder*, No. 594.

ROLLING IRON.

MR. CLAY has exhibited and explained to the British Association the model of a Machine used for Rolling Taper Iron, by which an iron bar may be rolled of any length and tapered to any required degree. The principle of the action of the machine consists in keeping one of the rollers fixed on its bearings by hydraulic pressure. A valve, regulated by a fine screw, permits the water to escape, and thus as the operation proceeds the rollers become more and more separated, and the iron bar less flattened. By regulating the valve, so as to allow of greater or less escape of the water, the degree of tapering can be very accurately adjusted. Mr. W. Clay also explained the construction and mode of fixing the large fly-wheel of the Warsey forge, which is the largest fly-wheel in the world. It is 35 feet in diameter, and 60 tons weight, and its axle is mounted on friction rollers.

ORE PULVERISING, WASHING, AND AMALGAMATING.

A MACHINE to perform this threefold process by one operation has been exhibited by the patentee, Mr. Perkes, at the Vulcan-wharf, Upper Thames-street. The crushing is performed by means of cones, working concentrically; and the principal advantages would appear to be the comparative cheapness of cost, quantity of work done, economy of power, and the utmost attainable amount of produce from a given quantity of ore; the fineness to which the ore is reduced being 15 degrees greater than that of wheat flour. All the ore must pass through sieves containing 6400 meshes to the square inch. The price of these concentrated conical machines ranges from 500*l.* to 2000*l.*, and the largest, which have six cones, weighing 7000 lbs. each, when set in motion by a steam-engine of 12-horse power, will subject to the triple process above mentioned about 20 tons per day.

TO RENDER SANDSTONE AND OTHER POROUS MATERIALS IMPERVIOUS TO WATER.

THE sandstone is first heated to a temperature of about 400° Fahrenheit, and then plunged into coal tar, heated to about the same temperature, and allowed to remain in it for about eight hours. In this way a mass is obtained so solid, that it is scarcely possible to break it with a hammer. Bricks and tiles require only four hours steeping, at a temperature of about 230° Fahrenheit. (Acid cisterns

and refrigerators of Yorkshire sandstone, and many other applications of that material, have been boiled, in this way, in tar, since several years, in many of the chemical factories of Great Britain, and with the best results.)—*Forster's Bauzeitung. The Dublin Monthly Journal of Industrial Progress*, No. 11.

STEATITE OR SOAPSTONE.

THIS new building material is coming into notice in New York, either in its purest state or in combination with other rocks. It is so soft that it can be cut with a chisel, planed, bored, sawed, or turned in a lathe. Yet it resists pressure very well, particularly when mixed with the harder ingredients, such as hornblende or serpentine. In beauty it is often found equal to marble, with even a greater variety of appearance. It bears an excellent polish, and, if broken, can easily be mended, by using its own powder as cement, so nicely as to be detected only by a critical examination. A house of this material was built at Northampton in 1807, and it is said to be still standing fresh and clear, to all appearance as if it had encountered only the rains of our last watery spring.—*New York Journal.*

AMERICAN STONE-POLISHING MACHINE.

THIS invention is described by Mr. Whitworth, in his special Report of the American Exhibition. The stone, we learn, is polished by a flat circular disc of soft iron, which is made to revolve horizontally. The axis of a disc is fixed at the end of a heavy frame, which moves round a strong centre shaft in a radius of about 12 feet. The polishing disc revolves at the rate of 180 revolutions per minute. It is driven by a strap, to which motion is given by a driving-pully fixed in the centre-shaft. The disc is guided and its pressure regulated by hand. It will polish about 400 square feet of surface in a day of ten hours.

PATENT TUBULAR BRACE.

THIS invention, by Knight and Co. of Ludgate-hill, Birmingham, is of the form of the ordinary Scotch metallic brace; but in consequence of its being tubular, is much lighter, equally strong, and less than half the price. It is manufactured by stamping; strong sheet-iron being used instead of the solid forged material. The manner of fixing the bits is important in the invention, which is upon the principle of the wedge, and very readily applied.

PATENT BARREL BOLT.

THIS differs from the ordinary bolt (made principally at Willenhall in Staffordshire), in its being manufactured without a single rivet. The barrel is pressed to the form of the bolt itself from the plate, thus causing the whole to be made from one piece of metal, and thereby securing ten times the strength of the rivetted bolt, as well as preventing the necessity for cutting away the wood upon which the bolt is to be fixed.

THE RAILWAY SYSTEM OF THE UNITED STATES.

The Railways, now an extraordinary feature of the United States, are rapidly developing the latent resources of the country. Mr. William Chambers gives an account of them, from which we extract the following particulars :—In October, 1853, the length of railways in actual operation in the States was 14,494 miles, nearly one-half in the New England States and that of New York. They are seen there radiating in several directions from every city, interlining and crossing and sending out branches. In Massachusetts alone, in the early part of 1853, there were about 1200 miles of railway—a large number for a State with one-third of the population of Scotland. At the same period, New York had 2123 miles; Pennsylvania, 1244 miles; and Ohio, a recently-settled State, 1385 miles. Large extensions have now been made in all; and the entire railway system of the United States at the present moment may be said to comprehend nearly 18,000 miles, with several thousand miles in course of construction. It is anticipated that, previous to 1860, there will be completed at least 35,000 miles. Already gigantic efforts have been made to unite the chief cities on the Atlantic with the Valley of the Mississippi and the vast regions westward and northward. Joined to the lines now constructed, and forming in Canada, the north will be thoroughly laid open for settlement; and connected with a line proceeding southwards from Illinois, traffic will be opened upon the one hand with Mobile and New Orleans, and on the other, with the regions bordering on Lakes Huron and Superior. The next steps are to reach Oregon and California, and are now engaging earnest consideration. The most urgently called-for of these lines is that to California, by a pass through the Rocky Mountains; and when this is effected, it will be possible to reach San Francisco in four days from New York, and by the additional means of steam-vessels, to go round the world in three months. Traversing from the borders of the Mississippi to San Francisco, a country 1600 miles in breadth, the line cannot be undertaken without liberal aid from the Government.

A RAILWAY UP A MOUNTAIN.

The Railway that connects the eastern and western parts of Pennsylvania, bringing the towns on Lake Erie and the great western rivers into direct communication with Philadelphia and the Atlantic, is carried over the lofty ridges of the Alleghany Mountains by a series of inclined planes. These are five in number, and the summit of the highest is 2600 feet above the level of the sea. The trains are dragged up each incline by a rope attached to a drum worked by a stationary engine. They are drawn across the plateaux which intervene between the inclines, in some cases by horses, in others by small locomotives. A new road is, however, being constructed, which will cross the mountains by one long winding incline. The ascent will be so gradual in its circuitous course that a locomotive will be able to ascend and descend with its train of carriages. It is calculated that *four hours* will be saved by the substitution of this

new route and the dispensing with the stationary engines.—*Mr. Whitworth's Report on the New York Industrial Exhibition.*

NEW RAILWAY.

MR. HENRY SMITH, of Michigan, proposes, says the *National Democrat,* laying the rails on cast iron posts, or columns, instead of wooden sleepers, sunk in the mud. The length of the posts will vary from fifteen feet, on a level, and even as low as ten feet, in passing over rising ground, to one hundred feet, the variations of the length of the columns superseding the necessity of grading, in a majority of cases. The posts extend above the rail sufficiently to admit of bracing and trussing to such an extent as to insure stability and perfect security. A speed of at least one hundred miles an hour is expected on this aerial road. (?)

RAILWAY FOG SIGNAL.

THIS signal, invented by Captain Norton, consists of a cylinder with a clasp made of sheet lead, or tin. The ends of the water-proof case are stopped with a circular piece of cork glued in; it is charged with a mixture of chlorate of potass, and sulphuret of antimony, equal parts. The igniter, made of a small transverse section of glass-tubing charged with percussion-powder, or the ends of Bell's new gas congreves, is placed in the centre, within the waterproof case; and the wheel of the engine passing over the signal, crushes the igniter, and explodes the signal with a very loud and sharp report.

If a copper percussion-cap be fitted on the nipple of the best cleaned fowling-piece, and placed in a dry room for a few days, the nipple will be covered with rust and verdigris: this proves that an iron nipple with a copper percussion cap on it is not adapted for the inside of a tin fog-signal.

When the wheel of the engine passes over the tin case without firing it, the powder within is scattered around by the fracture; but if the wheel of the engine passes over the paper case, the case is only flattened out, not fractured, and the second wheel passing over, fires it.

WIRE AND HEMP ROPE FOR RAILWAY PURPOSES.

THIS new rope has been patented by Messrs. Wright, of Birmingham. It is constructed of the best hemp and galvanized wire, spun together in the ordinary way by machinery. For a recent trial, the rope was 4¼ inches in circumference. It was secured to an engine at one end, and at the other to a goods' train of about 225 tons weight; this train the rope pulled easily; but a new hemp rope, of the same size, snapped in a few seconds on being subjected to the same test. The train was then increased to 300 tons weight, to propel which a second engine was required, and the patent rope was again applied, and found to answer perfectly. Mr. Parker, chief of the locomotive staff in Birmingham, stated that the hemp ropes used for the goods' trains were constantly breaking, and exhibited one of nine inches circumference, which a much lighter train than either of those above-

mentioned had broken only a few days before. Messrs. Wright also exhibited a patent binding rope, composed of wire and hemp, which was likewise severely tested.—*Times.*

RAILWAYS IN THE UNITED KINGDOM.

The Report on Railways for 1853 contains some noteworthy facts, illustrative of national progress. The length of the new lines of railway sanctioned by the Legislature during that year was 940 miles: 589 in England, 80 in Scotland, and 271 in Ireland. The length of railways opened up to the end of 1853 is 7686 miles: 5848 in England, 995 in Scotland, and 845 in Ireland. Of this number of miles, 6965 are of the Irish gauge of 5¼ feet, 626 of the broad gauge, and 95 of the mixed gauge. The length of single lines of railway is 1708 miles; 1135 in England, 132 in Scotland, and 441 in Ireland. The length of railways in course of construction on the 30th of June, 1853, was 682 miles; the men employed on them 37,764. The number of miles open for traffic on that day was 7512, and the number of men employed 80,409. The number of passengers conveyed in 1852 was 89,135,729; in 1853, 102,286,660; the receipts from all sources in the corresponding years were, 15,710,554*l.* and 18,035,879*l.*, the largest proportionate increase being in the receipts from third-class passengers. Looking at these returns from our point of view, this last is one of the most satisfactory of the facts they disclose. In its consequences upon the poorer classes, increased locomotion cannot but be beneficial; and the larger the proportionate financial return from third-class passengers, the greater their claim upon railway companies for increased facilities and accommodations.

THE VICTORIA BRIDGE AT MONTREAL.

The works of this stupendous undertaking are now in active progress. Its cost will be about 7,000,000 dollars, or about one-seventh of the total expense of building the 1112 miles comprising the Grand Trunk Railway of Canada.

The Bridge is to be tubular, on the plan of the Britannia Bridge over the Menai Straits. It will consist of twenty-five spans, or spaces for navigation between the twenty-four piers (exclusive of the two abutments) for the support of the tubes. The centre span will be 330 feet wide, and each of the other spans will be 242 feet wide. The width of each of the piers next to the abutments will be 15 feet; and the width of those approaching the two centre piers will be gradually increased, so that these two piers will each be 18 feet wide, or 3 feet more than those next the abutments. Each abutment is to be 242 feet long and 90 feet wide; and from the north shore of the St. Lawrence to the north abutment there will be a solid stone embankment (faced in rough masonry towards the current), 1200 feet in length. The stone embankment leading from the south shore of the river to the south abutment, will be 600 feet long. The length of the bridge from abutment to abutment will be 8000 feet; and its total length, from river bank to river bank, will be 10,284 feet, or 176 feet less than two *English* miles.

The clear distance between the ordinary summer level of the St. Lawrence and the under surface of the centre tube is to be 60 feet, and the height diminishes towards either side.

Each of the tubes will be 19 feet in height at the end, whence they will gradually increase to 22 feet 6 inches in the centre. The width of each tube will be 16 feet, or 9 feet 6 inches wider than the rail track. The total weight of iron in the tubes will be 10,400 tons, and they will be bound and rivetted together precisely in the same manner, and with similar machinery to that employed in the Britannia Bridge.

The piers close to the abutments will each contain about 6000 tons of masonry. Scarcely a block used in the construction of the piers will be less than 7 tons weight; and many of them, especially those exposed to the force of the current, and to the breaking up of ice in spring, will weigh fully 10 tons each. The total amount of masonry in the piers will be 27,500,000 cubic feet, which at 13½ feet to the ton, gives a total weight of about 205,000 tons.

Mr. Robert Stephenson and Mr. A. M. Ross are the engineers of the bridge, on behalf of the Grand Trunk Railway; and the contractors are Messrs. Peto, Brassey, Betts, and Jackson.

CASUALTIES OF TUNNELLING.

AT a late meeting of the Institution of Civil Engineers, a paper "On the Casualties of Tunnelling, with examples," was read by Mr. W. M. Peniston, and was in reality a relation of the difficulties encountered in the formation of some tunnel headings through chalk and green sand, under a head of water at Holywell, on the line of the Wilts and Somerset Railway.

The materials had been collected from the author's diary of the proceedings. It was intended that No. 1 tunnel should have been constructed in the usual manner by sinking shafts, and connecting them by a bottom heading running through between open cuttings at the north and south ends; there were, however, indications, from the borings, of the ground being unfavourable, the body of the tunnel being in chalk full of faults, whilst the cuttings at both ends were in green sand, and copious springs showed themselves along the line of operations, which were conducted through strata generally dislocated, and not to be depended on. In sinking the shafts, the water brought away with it such quantities of sand as to create cavities around, and produce serious failures in the timbering, which required to be renewed and replaced several times. Numerous contrivances were essayed for overcoming the difficulties,—gullets were cut at lower levels, in hopes of their drawing off the water, but the tenacity of the soil and the numerous faults precluded any chance of their being useful; nothing but incessant pumping could therefore be relied upon; but the consequence of this was, that the framing of the shaft sunk bodily, until it was retained by a hanging kerb and rods from the surface; then in spite of close sheathing planks, a lateral settlement occurred, and amidst a recurrence of these accidents the shaft was carried down until the sand and water

rose so rapidly in the bottom, that it was necessary to close it by a timber platform, through which the water rose to a certain level, whence it was pumped. Similar difficulties were encountered in the other shafts, enhanced, in one case, by the frequent recurrence of boulders of sandstone, which occasioned much loss of time and inconvenience in extracting them, and left large cavities behind the sheathing. The quantity of water also increased so much, that the briefest delay in pumping obliged the men to leave the headings.

At length, it being observed that the dip of the sand-rock, which was the water-bearing stratum, was in such a direction as to induce the inference that it might be used to convey the water away, by having it tapped at the lower level, the attempt was made, and was attended with success. In the subsequent extension of the open cuttings, the numerous vertical faults were shown to have been in a great degree the cause of the slips in the shafts.

In consequence of observations on the saturated strata, it was determined to try the effect of a syphon, which was accordingly laid down; it was formed of cast-iron pipes, six inches diameter, the short leg dipping into a hole at the bottom of one of the shafts, whilst the long leg extended through the crown heading, and terminated in a cistern in the north cutting. By means of a hand-pump at the upper bend, the air was exhausted, and the action was so perfect as to drain the blocks of sand and enable the headings to be completed.

Accounts were given of the numerous ingenious contrivances resorted to for overcoming difficulties, and also of the effects of the drainage upon the springs and wells in the neighbourhood. The various machines and devices employed were described in connexion with all the tunnels; in fact, the paper was, as it professed to be, a detail of the Casualties of Tunnelling, under circumstances of considerable difficulty; and it was well illustrated by a series of diagrams, showing the works in all stages of their progress.

THE AMERICAN TUNNELLING MACHINE.

TALBOT'S "Tunnelling Machine" has been tried with complete success; and it has been demonstrated that mountains of primitive stone and the hardest rocks in the earth can be successfully and economically tunnelled by the agency of steam applied to this new invention. The slow and expensive process of perforating by the drill and blast will be thrown aside. In the trial experiments, the machine moved by a steam-engine, cut an excavation of 17 feet in diameter through the hardest rock, at the rate of about 3 feet in two hours. The process consists in cutting and crushing the rock by means of rotating discs of steel, in successive series, which describe in their movements segments of circles from the centre to the circumference of the tunnel, with a gradual motion around the common centre; while the steam-engine is constantly pressing the machinery on a direct line with the axis of the tunnel. The newest and most extraordinary feature of the application of this power, consists in the combination of different sets of discs, which act upon the entire surface to be excavated by a

system of gradation perfectly regular, and by a power that is irresistible. The machine, which worked most satisfactorily, is made entirely of iron, and weighs about 75 tons, exclusive of the engine and boiler. One of the most interesting features of the experiment was when the machine began to cut the rock in an oblique direction, for it was observed that those discs or arms which were cutting the stone, moved with the same facility that those did which were playing in the air. Gradually the cutters described their curve, the great face-plate of 17 feet constantly revolved, throwing out and drawing back its arms with complete regularity, seizing and crushing the rock with irresistible power. Only four men are required to work this machine to the greatest advantage; and two of them confine their attention to the engine which propels it. There is no necessity for suspending the work day or night, except for those intervals when the cutters have to be sharpened, or new ones substituted. The amount of time and expense which is saved by the operation is almost incredible. This machine evidently supplies a want which has been felt in every department of civil-engineering. It will revolutionize the whole system of railway construction, and is regarded as one of the most wonderful inventions of any age.—*Jameson's Edinburgh Philosophical Journal*, No. 113.

We describe this new apparatus from the *American Mining Mag.*

This Machine is, in effect, a huge 17-feet auger, slowly turning at the rate of one revolution per hour, and advancing at the same time from 4 to 8 inches per hour, according to the solidity of the rock perforated. The common auger, as every one knows, is fitted with two fixed cutters, vertical to its centre, each cutting its way spirally into the wood. The cutters of this auger, four in number, are likewise fitted vertically to the centre, and cut their way spirally into the rock, with the combined revolution and advance of the machine. The only difference is in the construction of the cutters, which we shall presently attempt to explain.

The principal parts of the machine are as follows:—A carriage of massive iron resting on ways, and pushed forward at the rate above named, by means of a screw, turned by a simple contrivance similar to that which propels the carriage of a saw-mill, which is readily graduated to produce any desired speed, from 2 to 12 inches per hour. Upon this carriage rests all the machinery, engine included, and its total weight of 150,000 lbs. affords a sufficiently steady basis of operations to prevent the slightest perceptible tremor. 2. A great face-plate like that of a lathe, circular and vertical, resting and revolving on a hollow shaft large enough to admit the play of a horizontal beam, piston-like, through its cavity. 3. Four sectors (as if a wheel were divided into quarters), with their apexes hinged upon the face of the plate in such positions, equidistant, as to bring their segments of circumference at right angles to each other, meeting at the centre of the plate. The horizontal beam above-mentioned connects by an arm with each of these segments, at their corners, which meet at the centre of the plate; and in playing back and forth, causes *each to vibrate in* a segment of a circle which passes through half the

diameter of the tunnel, the four meeting at the centre. 4. The circumference of each sector is armed with three small wheels having teeth, not unlike circular saws, set obliquely, so as to strike the face of the rock in the same direction as a stone-cutter's chisel, and to act upon it in substantially the same manner, as they are rolled upon it back and forth by the vibratory swinging of the sectors. Each cutter in succession thus steadily carves away its proper thickness of rock, as it swings back and forth from the centre to the circumference of the tunnel, urged against the rock by the slow advance of the carriage, and borne around by the revolution of the face-plate. The thickness of the shaving carved away by each cutter varies from 1 to 2 inches, according to the hardness of the rock.

Four cutters, passing around once in an hour, and each cutting 1½ inches deep, make, of course, a progress of 6 inches per hour. It is said that, after allowing for all necessary interruptions, the machine may be run steadily for twenty hours out of twenty-four; making a progress of 10 feet per day. Sixty horse-power of steam, two engineers, and two men to shovel out the broken rock, comprehend the expense of working the machine at this rate; to which the expense of keeping up the cutting-wheels is the only additional item of importance which seems necessary to be added.

MACADAMIZED ROADS FOR THE STREETS OF TOWNS.

MR. J. R. SMITH has communicated to the Institution of Civil Engineers a paper on this subject. The lengthened experience of the Author, as Surveyor to the Corporation of Birmingham, having under his charge about 150 miles of street road and 50 miles of turnpike road, enabled him to express confident opinions, on the comparative cost, durability, and general qualities of paving and of broken stone, for roads and even for streets, subject to a considerable amount of heavy traffic. The parties chiefly interested in having good roads, were shown to be the owners of carriages and horses, and the ratepayers, at whose expense the roads were originally constructed, and subsequently maintained. For both these classes, "cheap roads" (*i.e.* those of small first-cost) were contended, generally, to be the dearest; horse-power being uselessly expended, carriages destroyed, and constant repairs to the surface of the road being necessitated. Any undue increase of tractive power was shown to fall indirectly on all who purchased any commodities conveyed through the streets, and the annoyances and hindrances to commerce, arising from ill-paved, ill-kept, muddy, dirty, and noisy streets were patent to all. The necessity was thence deduced for having the roads and streets so constructed that the surface should be firm, even, and smooth, without being slippery, and be free from mud, or dust, or loose stones. To attain this, the foundation should be of firm material, well consolidated, and perfectly drained, then covered with stones broken to uniform dimensions, well raked in and fixed by a binding composition of grit, collected during wet weather by Whitworth's sweeping machine and preserved for the purpose. This binding being regularly laid on, and watered, if in dry weather, would in great thoroughfares consolidate the new

metal in a few hours, preserving the sharp angles of the stones, which assumed all the regularity of a well-laid pavement, with a considerable saving of material, and a firmer crust than by the ordinary method of allowing the vehicles to pass for many days over the uncovered surface of the new stones, grinding off the angles, with a deafening noise, and forming dust, or mud, to be carried on to the footpaths and into the houses and shops. Instances were given of the advantages of this system of using the grit for binding, which should, however, be that collected by the sweeping machines and not mere slimy mud. A street in Birmingham subject to great traffic, had been thus perfectly made and consolidated in five days, whereas, under the ordinary system, three months would have been required to produce the same effect. The repairs were capable of being effected at any period of the year: under no circumstances were the street surfaces permitted to be worn down, and they were never stopped, as was the case for lifting and repaving. The greatest amount of wear and tear of Macadamized Street Surface, in Birmingham, was shown to be four inches per annum; the average might be therefore taken at two inches; the cost of maintenance was 4*d.* per superficial yard, and that of watering and cleansing was 2*d.*, giving a total of 6*d.* per yard per annum. Paving cost 15*s.* per yard, it required to be renewed once in fifteen years, and the cleansing cost about ½*d.* per yard. Paving was, therefore, evidently about double as expensive as macadamizing, at Birmingham. It was, therefore, contended, that macadamized roads and street surfaces, if properly constructed and carefully managed, well water-cleansed for mud and watered for dust, brushed or swept by machinery maintained with an uniform surface, and not permitted to become degraded, were well adapted for towns and cities of average traffic, and for many localities in and around the metropolis.

In the discussion which ensued upon this paper, numerous details were given of the comparative prices of the materials in the country and in the metropolis,—the method of laying them down,—the successive employment of set paving-stones in large thoroughfares, then in less frequented streets, and ultimately breaking these up for macadamizing; thus giving the materials an almost unlimited duration. The use of the grit, as collected by the sweeping machines, was admitted to be advantageous for binding the metalling quickly, and preventing the abrasion of the angles of the stones. It was, however, shown that the traffic of country towns was so vastly inferior in amount and weight to that of the metropolis, especially since the introduction of the heavy railway and other vans, travelling at considerable speed upon comparatively narrow wheels, that a system of forming streets or roads which would endure well in one case was not applicable for another; and hence the present bad condition of Parliament-street and other streets which had been macadamized; and which it was contended could only be maintained even in their present state at a cost greatly exceeding that of the paved streets of the City.

HYDRAULIC APPARATUS FOR SHUTTERS.

A HYDRAULIC Apparatus, for raising or lowering Shutters, has been erected on the new premises of the Standard Assurance Company, in George-street, Edinburgh. The water is supplied from a cistern placed on the top of the house, a height of about fifty feet, and is conveyed by a one-inch pipe into a cylinder fitted with a piston, which, by the pressure of the water, raises or lowers the shutters. The machine is worked by turning a small handle.—*Scotsman.*

HYDROSTATIC PERCOLATOR.

M. LOYSEL has exhibited to the Institution of Civil Engineers, a very simple and ingenious Apparatus, for Extracting Colouring Matters from Dye-woods; and also for obtaining infusions, or extracts of vegetable substances, for medicinal or other purposes. The principle of action is that of direct hydrostatic pressure, applied by a simple and inexpensive apparatus. The substance to be operated upon is placed within a cylinder, whose bottom is finely perforated; a similar pierced diaphragm is then placed over it, so as not to produce any pressure; the liquid, either cold or hot, is poured into an upper reservoir, whence it descends by a centre tube, to beneath the lower diaphragm, and is forced upwards by the pressure, through the superposed substance, every particle of which it saturates in its passage, expelling the air, and carrying before it all the finest portions, to the upper strata, against the under side of the upper diaphragm. When a sufficient quantity of liquid has been passed, or the infusion is completed, a cock is opened, which permits the infusion to return, from above, by its own specific gravity, through the substance already operated upon, thus completing the abstraction of any colouring or other matter not previously taken up, and at the same time filtering the liquid. By a second and similar process, anything still remaining in the substance can be extracted. It is practicable, by varying the height of the column, to give any degree of pressure, and by the application of a lamp, or, in a large apparatus, of a coke fire, the temperature of the decoction can be maintained as may be desirable. By another modification, the steam generated in a small boiler regulates the action of the apparatus. The system is described as being adapted to very numerous purposes, and the familiar application of it to making coffee was exhibited. The apparatus consists of one vase, either of glass, china, or metal, whose cover, on being reversed, forms the reservoir and pressure column; and by it, in a very few minutes, clear, strong coffee is produced. It was stated that in an apparatus adapted for a large establishment, four gallons of coffee had been made in twenty minutes.

LIFTING BRICK BUILDINGS BY HYDRAULIC PRESSURE.

A LETTER from San Francisco, in the *North American,* states: "They are now grading the streets of the city, filling in some and cutting down others. When the former process is being done, it becomes necessary to raise the houses. You have heard of moving

houses entire, but here we lift them up by Hydraulic Pressure. Whole piles of brick buildings are being raised in this mode where the streets have been filled up, and thus the lower floors are brought up to the new level of the streets. Last week a warehouse belonging to Alsop and Co. 50 feet front and 70 feet deep, having three stories and a basement, a heavy brick building, was raised 5 feet, and then under-built with stone, all without moving out, or even disturbing the clerks with their pens at the desks! Another store, not quite so large, but having in it 2000 tons of hardware, was raised in six days, and a new story added to it at the bottom."

LAYING PIPES, AND THEIR JUNCTION.

THE Earl of Dundonald has patented a Carriage having a cutter for vertically parting the earth, with a horizontal tool attached like that of a drain-plough. From the upper part of the carriage a duct descends obliquely to the tool, through which duct drain-pipes or other pipes, connected by an elastic or other rope, may be continuously deposited in the channel formed by the progressive motion of the apparatus. The junctions may be lubricated by the machinery with clay.—*Builder*, No. 612.

HYDRAULIC POWER IN GRIMSBY TOWER.

NEARLY all the works of the Grimsby Docks are carried on by means of Hydraulic Power, supplied from a tower, which rises from the centre pier to the height of 300 feet, and can be seen sixty miles out at sea. A steam-engine of 20-horse power, placed at a distance of three-quarters of a mile, pumps into a tank erected in this tower, at a height of 220 feet, a never-failing supply of water. In this way, by mechanism familiar to engineers, a degree of hydraulic power is obtained which at Grimsby serves to open and shut the immense lock-gates, to regulate the sluice-gates, to work the cranes for discharging and for loading ships, and to hoist goods into and out of the lofty warehouses. All this work is accomplished with an ease which appears marvellous, when contrasted with old modes of performing the same operations. For example, at the Liverpool Docks, some sixteen men take half an hour to move a pair of 70-feet gates. At Grimsby, gates equally ponderous can be moved by two men in a couple of minutes. The Grimsby Dock is the only one in the kingdom at which hydraulic force has yet been brought so completely under control for performing the varied handiwork required upon the quay side, but the principle is now being extensively applied, as we long since anticipated it would. Mr. Rendel, the engineer, has been deservedly complimented upon the successful issue of the great works there, which, carried out under extraordinary difficulties, have led to the reclamation of 130 acres of land from the sea, and to the construction of a dock 20 acres in extent, and a tidal basin with an area of 13 acres, affording most complete facilities for the landing and shipment of merchandise.

IMPROVED INCLINED PLANE.

There has been described to the Institution of Civil Engineers, an improved Inclined Plane, for conveying boats to and from different levels of a canal, by Mr. J. Leslie. After alluding to the successful inclined plane, established by the author, at Blackhill, near Glasgow, on the Monkland Canal, and describing the difficulties to be overcome, and the points essential for the good working of such lifts, the paper proceeded to propound, as the simplest modification, in cases where there was a scarcity of water, and where vessels would bear being taken out of the water, the having two uniform inclined planes, descending each way, from a culminating point, or summit, placed at a suitable elevation, above the water in the upper reach.

GILLESPIE'S PATENT INCLINOMETER.

Various recommendations of this new instrument are quoted by the *Nottingham Guardian*, which also gives a personal recommendation of it, as a very useful means of insuring accuracy in levelling, sloping, drain cutting, and all road and railway work. It is said to be easily worked even by the common labourer, being so simple, that by its means "levelling is brought within the reach of all men of ordinary capacity."

SHIPMENT OF MARBLE FROM CARRARA.

Those who have visited the marble quarries at Carrara, and seen the immense and laborious traffic carried on there, must have been surprised, and unfavourably so, at witnessing the process of shipping the blocks.

The coasting vessels to be loaded are drawn up on the beach, and shears erected alongside, by means of which, and a clumsy capstan and tackle, the blocks are hoisted on board. With blocks of ordinary dimensions, this is the plan adopted; but when these happen to be of extra sizes, another most singular method is employed. The vessel in which a large block is to be embarked, after being hauled up on the beach, has her masts taken out, and the hold filled with sand, an inclined plane of the same material being raised from the shore to the side of the craft: these preparations completed, oxen are yoked to a sledge on which the block is placed: it is then dragged up the incline, and ultimately deposited in the centre of the hatchway. The sand is next thrown out, and the marble gradually lowers into its place. The expense and delay connected with this system are beyond conception. Weeks are often lost waiting for fine weather, and sufficient depth of water for relaunching the loaded craft, which, if of a large size, as a precaution against her capsizing, is bound round with empty casks. Oxen and men then lend their assistance, and by their united efforts the vessel is dragged into the sea.

Such is the system that has existed to the present day, which appears the more extraordinary when it is considered that nearly one thousand tons of marble are shipped monthly. To remedy this,

the Walton Pier has been constructed by a marble merchant of that name, and American consul, at his sole expense.

This bold and enterprising work, forming a double line of rails, is constructed on piles of from sixty to ninety feet in length, and extends into the sea nearly eight hundred feet. The timber for its fabrication was brought from the Apennines beyond Florence, down the Arno to Leghorn, and from thence, by boat, to the works.

His Royal Highness the Duke of Modena gave ready permission to Mr. Walton to construct the pier, and remitted half the duties on all the materials imported and applied to its construction. The engineer, Mr. Thomas Robertson, of Leghorn, was enabled to complete the undertaking in thirteen months.

The Duke of Modena has granted permission for the formation of a railway from Mr. Walton's pier to the marble-quarries and the city of Massa.

There are now two powerful cranes, of improved construction, at full work on the pier.

SLIDING CAISSON AT KEYHAM DOCKYARD.

At a late meeting of the Institution of Civil Engineers, "A Description of the Sliding Caisson, at Her Majesty's Dockyard, Keyham, Devon," was read by Mr. W. Fairbairn.

The substitution of caissons for the ordinary lock-gates, and their employment for closing the wide entrances of docks, was first suggested in this country by General Sir Samuel Bentham; since his time they appear to have been somewhat extensively used, although the objections of occupying a considerable time in having the water pumped out of them, and it being necessary to float them entirely away from the opening before a vessel could pass, rendered them applicable only for special localities. The great width of opening required for the passage of ships of war, induced a rather general use of such caissons in the royal dockyards; and at the new dockyard at Keyham, where it was considered desirable to have the best accommodation for the newest class of large ships, the great breadth of the mouth and the depth of the basin induced the trial of a new form and arrangement of caisson, which should be of such capacity and dimensions as to resist the pressure of the water, effectually close the entrance, and still be so easy of manipulation as to admit vessels of war passing into the dock at any state of the tide.

The Keyham Docks were described as extending along the eastern shore of the Hamoaze, immediately below Morris Town; their construction was commenced in 1844, and they consisted principally of two capacious basins, with several entrances or locks from the sea; one of these it was thought desirable to construct in such a manner as to have the power of using it, when necessary, for a dry dock; its dimensions were 260 feet long, 80 feet wide, and 43 feet deep; the inner end, next the dock, was closed by a caisson of the ordinary form, and at the outer end, next the channel, the new caisson was tried. It was designed by Mr. W. Scamp, of the Admiralty, and

was constructed by Mr. W. Fairbairn, by whom a description was transmitted to the Institution.

The form of the caisson was that of a rectangular vessel, 82 feet 6 inches long at the top, 68 feet 6 inches long at the bottom, 42 feet high, and 13 feet 6 inches wide; it was built of wrought-iron plates, varying in thickness from $\frac{5}{8}$ of an inch, at the bottom, to $\frac{3}{8}$ of an inch at the top, well supported throughout by an inside frame-work of angle iron and gusset-pieces, and by two decks of iron and one of timber for the interior arrangements, but which at the same time imparted great strength to the structure.

The plates were connected by "butt-joints," with covering plates, attached by double and quadruple rows of rivets, and the bottom and ends were clothed with oak timber which bedded upon the cill, and against the jambs, when the caisson was in its place. The internal arrangements of the caisson were such, that when it was required to withdraw it from across the opening of the lock, by merely opening a valve, a sufficient quantity of water escaped from the upper chambers, to allow the body to rise a few inches from the bottom cill, when instead of, as in the ordinary system, turning it round and floating it away, it was drawn back, by chains, transversely into a channel or opening in the masonry, at right angles with the lock, leaving an opening of the clear span, and after the passage of the ship, it was drawn across again, and by opening another valve, as much water entered as settled it securely on its bed or cill. This operation was stated to have occupied only eighteen minutes for the passage of a line-of-battle ship; ten minutes for opening and eight minutes for closing. The total weight of the caisson was shown to be 290 tons; it contained 33 tons of iron ballast, and had an internal capacity for 323 tons of water. The mechanical arrangements were minutely described, and the general result appeared to have been very successful; and from the tabular statement of the deflection of the caisson, under the pressure of various depths of water, the structure appeared amply strong for resisting either the dead pressure, or the concussions of the waves which frequently beat heavily against the entrance of the docks.*

COMPARISON OF IRON AND WOODEN VESSELS.

In a note attached to his translation of Fincham's "Outline of Shipbuilding," M. Nillus, of Havre, makes some interesting remarks on the comparative advantages of Wooden and Iron Vessels, which we here present in an abridged form. Almost all vessels, whether in wood or iron, have hitherto been constructed on a wrong principle. The greatest possible strength has been given to the sides and bottom, while the deck has been neglected. But a ship should be regarded as a great tube, or box, capable of sustaining a load at its middle while suspended at its end; or, conversely, of sustaining loads at each end while supported at the middle. To obtain this result with the least weight of materials, the upper and lower parts of the vessel,

* Two engravings of these docks, admirably drawn by E. Weedon, will be found in the *Illustrated London News*, No. 654.

otherwise the deck and the bottom, should be the strongest. Instead of this the deck is usually slight and weak, and is generally regarded only as a platform to be used for working the ship, or as a covering to keep the water from the interior of the hull. Iron ships should form a tube, closed at each end, and strengthened by ribs and cross-beams forming continuous pieces, so that the tube might be considered as strengthened by a series of rings. The sides should, of course, be rivetted to the ribs, so that the whole would form something analogous to a tubular bridge. Even the present construction of iron steamers is much superior in solidity to that of wooden ships, as a few examples will suffice to show. The *Great Britain* remained during the entire length of a severe winter fixed on the rocks of Dundrum, and when released from her critical position, was capable of being so repaired as to become a packet-ship to Australia. A recent example is furnished by the *Ward Queen*, constructed by Scott Russell, with a length twelve times as great as her maximum breadth, a very high proportion for a sea-going vessel. This small steamer was employed between New Haven and Dieppe at the period of the accident. In entering the port of New Haven, at low water, with the channel too shallow, she grounded heavily, and was suspended by the middle. A breaker took her broadside on, and cast her on the beach, where the passengers easily and safely disembarked. Notwithstanding the force with which she was cast ashore, she was again launched without any strain, and was able to proceed to London for examination. After a careful inspection, no important injury could be discovered. A wooden vessel of the same dimensions, under similar circumstances, would doubtless go to pieces, or, at least, be seriously damaged.

To show that the annual cost of wear and tear is less with iron than with wooden vessels, M. Nillus refers to two steamers, each of 90-horse power, between Dover and Calais. One of these, the *Midgeon*, is of wood, and cost 10,121*l.* The other, the *Dover*, is of iron, and cost 10,153*l.* The annual repairs of the *Midgeon* cost 668*l.*, while those of the *Dover* cost only 293*l.* The wooden vessel thus requires 6·6 per cent. of her first cost for annual wear and tear, while only 2·87 per cent. of the first cost is required for the iron vessel. This extraordinary proportion in the relative cost of wear and tear in these two vessels might be, in part, attributed to the *Midgeon* being two years older than the *Dover*; but this would be far from completely explaining it. Hitherto, iron vessels have entirely failed for the purposes of war. Numerous experiments made in France and England have clearly demonstrated their inapplicability. A ball fired at an iron hull strikes the side, and continuing its course right through, will come out at the other side; sometimes it breaks into dangerous splinters, which will kill and wound in all directions. Moreover, it is impossible to perfectly close up the hole left by a cannon-ball in the iron plate from the jagged edge turned to the interior of the ship. M. Nillus concludes that iron is much preferable to wood as the material for merchant and passenger vessels, but is entirely unsuited for the construction of ships-of-war.—*Dublin Monthly Journal of Industrial Progress*, No. 12.

COMPARATIVE COST AND ADVANTAGES OF IRON AND WOODEN SHIPS.

MR. JAMES HODGSON, of Liverpool, who states that he was the builder of one of the first iron sailing ships, and of the first iron screw steamers running between Liverpool and several foreign ports, has issued a circular, in which he states some of the alleged advantages of Iron over Wooden Ships. From documents quoted, it appears to be considered that a well-built iron ship does not depreciate more than 2 per cent. per annum, and that with good care in cleaning and painting, the durability of iron vessels will be very great, and their rate of speed considerably beyond the average. The managing owner of one built on Mr. Hodgson's patent, however, starts a serious question. "Would it not be well," he says, "to give more longitudinal strength in some of the very long vessels; for do not the rivet holes in the vertical joints of the plates, and in the rivetting of the bulkhead, almost cut the vessel in two?" Was it not on this account, we may ourselves ask, that some iron ships have actually broken up suddenly into two halves? Surely something has already been done, however, to remedy so serious a fault. Yet the question quoted is dated no further back than June, 1851; and, if obsolete, why is it quoted at all, especially in such a circular? An iron ship of 1000 tons is stated to cost only 13,500*l.*, a wooden one 16,500*l.*, and in cost of working such ships there is said to be an annual total of 2295*l.* in favour of the iron ship.—*Builder*, No. 580.

RAISING SUNKEN VESSELS.

IT is well known to many persons that, in consequence of the inefficiency of the methods at present employed for Raising Sunken Vessels and other property, the wrecks upon our coast are now almost wholly abandoned by the owners. Mr. Trestrail has, however, lately invented a plan for effecting this object, the main feature of which consists in the employment of the buoyant power of gases generated under water.

The gases at present employed by the inventor are produced by the slow combustion of gunpowder mixed with other ingredients, which are previously prepared, and placed in metal caissons which have at their upper extremities air-tight chambers (for the reception of the combustibles) fitted with valves communicating with the interior of the caissons, which being filled with water admitted through valves placed at their lower extremities, are made by their specific gravity to sink and descend to the divers, who secure them to chains or cables passed round the sunken wreck; and, when they are firmly attached thereto, the gas-generating power is set in action by the divers below by a simple detonating process; vulcanized India-rubber bags, connected with retorts, being also, when necessary, placed within the hold and cabins of the sunken ship, and inflated by the means described, to give it still greater buoyancy.

It is clear that when a number of these caissons, attached to a sunken vessel, have been thus rendered buoyant, they will exert a lifting power in proportion to the quantity of water displaced from *within them by the gases* produced, and, consequently, when suffi-

ciently buoyant to overcome the specific weight of the sunken vessel and cargo, and also its adhesion to the soil on which it lies, the entire vessel must be raised to the surface of the water, and there sustained.

The following advantages result from this arrangement:—

That which generates the lifting power is prepared on shore, and kept in constant readiness for use; it is placed within the caissons or retorts, and set in action, when required, by the diver, without communication with the surface. The volume of gas, and consequent lifting power, can be increased *ad infinitum:* the lifting power is exerted more equally on all parts of the chains, or sunken vessel, than by the ordinary methods, and the wreck, when raised to the surface of the water, is kept afloat, and can be readily towed into harbour by another vessel.

This invention contemplates also the prevention of ships from sinking. For this purpose it is intended to place under the deck-beams, and other parts of vessels, vulcanized India-rubber bags, rolled and confined within suitable boxes. When the vessel, from any cause, is in danger of sinking, the bags are to be liberated from their boxes, and inflated by means of gas-generators communicating with them, care being taken to render the deck sufficiently strong to bear the upward pressure.—*Mechanics' Magazine,* No. 1598.

CLARKSON'S LIFE-BOATS.

Mr. Clarkson, of Wapping, has invented two Life-Boats of a material which he has patented, composed of alternate layers, or laminæ, of canvas, cork, and wood, united to each other with marine glue. One of the boats is 28 feet long, 7½ feet wide, and 3 feet 2 inches deep, with a water-tight deck, and having raised end air-boxes to assist the vessel in righting if upset. The boxes are also adapted to the boat so as to be removed at will and thrown to persons in the water. They are capable of sustaining several persons. Her ballast, the disposition, character, and amount of which in a life-boat is of much importance, is differently arranged from that in other descriptions of boats. Mr. Clarkson has left a longitudinal channel or opening in the deck of his boat amidships fore and aft, above the keel, in which pigs or bars of iron are stowed up to the level of the deck, and so secured that they should not fall out in the event of the boat upsetting. Although the ballast placed in this raised position above the keel will not act with the same powerful leverage on the boat's heeling over, yet for flat and shallow beaches it would possess the advantage of making her draw less water, and would also render her motion more easy when rowing with a broadside sea on.

The material used by Mr. Clarkson appears to have great solidity and strength, while from its elasticity it is less liable to injury from concussion against a rock or other hard substance. Another peculiarity of the boat is lightness, her weight not being more than 27 cwt., which is about a quarter less than that of a wooden boat of the same *dimensions,* and fitted in the same manner. Although Mr. Clarkson

is not a professional boat-builder, or at all acquainted with ordinary boat-building, he has displayed great skill and ingenuity in the construction of this boat. Another boat of large dimensions was afterwards overturned in the water, when it immediately righted itself. Some of the fittings were then thrown overboard, and a number of boys swam to them, and by their assistance floated about and used the air-boxes as rafts. The experiments were satisfactory.

PARRATT'S LIFE-RAFT.

A MODEL of this Raft, which has proved very successful in practice, has been exhibited to the Society of Arts. The raft is composed of two rows of vulcanized Indian-rubber tubes, inclosed in canvas-bags and nettings, the two rows meeting at their ends, and forming, when extended, by means of some spars, a contrivance which is capable of being rowed like a boat.

LIFE-PRESERVER SEAT.

SOME successful experiments are reported to have been made at the Navy-yard, in Washington, upon a Life Preserving Seat, invented by Mr. N. Thompson. The seat forms a ship stool of the usual size, convenient, neat and substantial, and can be converted into a life preserver in a moment, by moving two brass slides, which allow it to divide and open, and then by moving the slide a few inches more, they hold it firmly in that position. It then forms a strong frame, with a capacious air chamber at each end, and the person is supported in the water without effort, the sides coming up under the arm-pits, and leaving the arms and legs free. An experimenter, who had never before seen the apparatus, threw himself, with it, into eighteen feet water, and managed it in many ways with perfect ease.—*Scientific American.*

PROGRESS IN THE SIZE, FORM, AND POWER OF SHIPS, ETC.

THE immense steam-ship *Himalaya* lately completed by the Peninsula and Oriental Company, is 40 feet longer than the leviathan war-steamer, the *Duke of Wellington.* Nine immense boats hang over her sides: the engine-room looks like a large manufactory: the tunnel for the shaft of the screw, in ordinary vessels about big enough for a man to crawl along, is almost as large as a railway tunnel. The ship is as long and wide *as a London street,* and a person at one end of her cannot, with the utmost powers of his voice, make another hear at the other end. Calshot Castle, the ancient defence of Southampton harbour, might be stowed away in her hold. The fittings of this vessel are superb: the curtains for the saloon costing three guineas, and the damask five guineas, a-yard. The engines give immense speed, enabling her to take 2000 passengers to America in a week, or 2000 soldiers to the Cape in three weeks. She is prepared, in case of war, to carry guns for her defence; but these, it is thought, would be quite unnecessary, as she would run down any man-of-war, and a vessel would be only too glad to get away from her. The *Himalaya cost 150,000l.*

The Queen's new yacht will be built of solid mahogany, upon the diagonal planking system. The principal dimensions are:—Length over all, 315 feet; length of keel, 300 feet; breadth, 40 feet; and depth of hold, 22 feet. A high rate of speed is anticipated from her form in combination with Penn's oscillating engines, with 28 evolutions, giving a speed of 16 or 17 miles an hour. The tonnage of this yacht is estimated at 2400.

The sails of the *Great Republic*, spreading 28,000 yards of a suit, were completed by the sewing machine in six days: by the old process of hand-sewing, it would have taken 1200 days for the same work.—Selected from the *Builder*. No. 575.

PROPULSION OF VESSELS.

SEVERAL patents have been taken out for the propulsion of vessels by hydraulic pressure against the back water, thereby forcing the vessel forward. Mr. Higginson has patented a plan on a somewhat similar principle, termed by him "Hydraulic Pressure Steam Navigation," on which patent a company has been formed, and it has been publicly stated that fifty miles an hour can be obtained. Mr. Higginson, according to a contemporary, has actually obtained forty miles an hour out of an old tub of a vessel in which he placed his machinery! A new vessel is now being got ready to launch, which will settle this important question. The principle of the system of propulsion, patented by Mr. Gwynne, is the suction of the water through a tube at the bows of the vessel by two of Gwynne's centrifugal pumps, by which also the liquid is ejected at the stern, propelling the vessel forward with a speed, it is anticipated, very far surpassing anything yet accomplished by paddle-wheel or screw. His system comprises a two-fold source of power—first, from the partial vacuum, caused by the indraught of water at the bows of the vessel, alone causing it to advance, filling up the displacement of water; and, secondly, the much greater force engendered at the stern by the rapid ejection of the water, adding to the velocity of the vessel in the same direction.

NEW METHOD OF DRIVING SCREW PROPELLERS.

AN interesting experiment has been made on the Seine with a small clipper, a *mètre* long, furnished with a particular system of sails disposed so as to communicate motion to a screw, which was intended to propel the vessel in the same manner as an ordinary screw driven by steam. M. Salles, the inventor, and M. Signol, who have executed the mechanism, have given to their system the name of the "*hélice éolienne.*"

With an ordinary breeze, the *hélice éolienne* of the little clipper attained on the trial a mean speed of 120 revolutions a minute, and communicated to the miniature vessel a good velocity in all directions. The inventors hope that their discovery, when applied to ships, will give results analogous to those obtained in steam vessels, and that their screw, not less than that driven by steam, will be capable of *being stopped, or set in* motion, either ahead or astern, easily and

with promptitude. If experiments made on a large scale give the sanction of practical utility to this invention, it will undoubtedly induce radical changes, by combining the use of sails and of steam. The ordinary screw will of course be retained, and the steam engine that propels it, but the former will also have adapted to it the proposed mechanism for transmitting to it the force of the wind also; so that when a sufficient breeze blows, from any quarter, a great saving of fuel may be effected. One of the consequences of the application of the *hélice éolienne* to steamers will be that those which run in latitudes in which the trade winds blow, with a constant force and in the same direction during a part of the year, will be enabled to devote to passengers and merchandize much of the space now appropriated to the stowage of fuel.

Messrs. Salles and Signol propose, after having effected in it what modifications may be deemed necessary, to submit their invention to a competent commission. It is to be hoped that the examination will prove favourable to their discovery, and recompense them for their labours.—*Journal de Rouen.*

THE CALORIC SHIP "ERICSSON."

The *New York Courier* thus describes a trial trip of this vessel, and the accident by which she has been disabled:—

"When the ship left dock, the engineer, being uncertain how long she might be detained in getting out, allowed the fires to get very low, so that when she started she made but seven revolutions per minute. As her fires brightened, her power increased; passing the battery she made eight turns, and at a distance of five miles beyond her revolutions had reached ten per minute. Her speed increased as she progressed, making finally full twelve turns, and she reached the measured distance of 18 miles from Governor's Island in 1 hour and 35 minutes, being a little less than 12 miles per hour. Going down the tide was favourable, but the wind was strong a-head, which nearly counteracted the favourable influence of the tide. Returning, although the tide was unfavourable, she made 12 miles per hour, passing a measured distance of 8 miles in precisely 40 minutes. Her engines, which are simply and admirably planned and constructed, worked with extraordinary precision and steadiness, turning the centres so strongly and steadily, that the eye could not detect the least diminution of power. The highest working pressure at any one time did not exceed 10 pounds per square inch. This pressure will be greatly increased by a slight alteration about being made in some of the connecting pipes, which it is confidently expected will give 30 or 40 pounds' pressure, or even more. And now to come to the most important and distinguishing point involved in the practical working of this ship—the economy of fuel. The great question—how much coal will be required to propel a ship of her tonnage (2200 tons) 24 hours, at the rate of 12 to 15 miles per hour, was clearly *solved by the* experience of this trip. Not over, *certainly, 10 to 12 tons will* be needed, requiring 120 to 150 tons for a *voyage to Liverpool, or nearly* 1000 tons less than the Arabia or

even the *Atlantic* sometimes consumes, and employing only about one-eighth of the working force of those ships. No comment on such results is needed. That a complete revolution in steam navigation will be the consequence is clearly evident. On her return from the trial trip, on arriving opposite pier No. 8, North River, she was struck by the severe squall, which careened the starboard ports under water. These ports had been opened by the men below for the purpose of observing the speed of the vessel through the water. Instead of closing them, as they should have done, they left them open, and ran away upon the pouring in of the water, and the captain, who was busily engaged in avoiding vessels at that moment (the river being full of them), was not acquainted with the fact until it was too late to remedy the evil. The ship gradually filled, and then sunk in about six fathoms of water, within 300 yards of Jersey city—all the persons on board escaping. She lay in soft mud, perfectly upright, her upper deck being about four feet under water."—*Times.*

On May 12, the *Ericsson,* having been raised and nearly exhausted of water, was towed over to the Navy Yard, and moored in the stream opposite the ship-houses, the tide not being high enough to take her into the stone dock, to have some further alterations made in her machinery, which were contemplated prior to her recent disaster. She still drew not far from 20 feet of water, as she had not been thoroughly pumped out, nor the muddy sediment that collected in her while submerged removed.

COMPOSITION OF THE SHEATHING OF SHIPS.

M. Bobierre has paid considerable attention to this subject, and has arrived at the following conclusions as to the cause of the rapid destruction of some copper and bronze sheathing :—1. When unalloyed copper is employed, the presence of arsenic appears to hasten its destruction. 2. All bronzes which appear to have stood well, contained from $4\frac{1}{2}$ to $5\frac{1}{2}$ per cent. of tin, that quantity being necessary to form an homogeneous alloy. When the percentage of tin is only 2·5 to 3·5 which is very frequently the case, no definite alloy is produced, and the mass is of equal composition, and being unequally acted upon is soon destroyed. 3. When impure copper is employed, the alloy is never homogeneous, and is unequally acted upon in consequence. We thus see that the so frequent destruction of the sheathing of copper-bottomed vessels arises from the tendency to use inferior brittle copper, and by diminishing the proportion of tin, to economise the difference between the price of that metal and copper, at the same time that the cost of rolling is also less, in consequence of the greater softness of the poor alloy. Bobierre thinks that the addition of a very small portion of zinc very much improves the bronze, by producing a more perfect and uniform distribution of the positive metals, and consequently a much more definite alloy.—*Comptes Rendus.*

A MONSTER CYLINDER.

The casting of the largest Cylinder in the world has been successfully

accomplished at Messrs. J. Scott Russell and Co.'s building-yard, Millwall. It is the last of four intended for the new iron steam ship now being built by Messrs. Scott Russell and Co., for the Eastern Steam Navigation Company, which when completed, will be the largest steamer afloat. This cylinder cast is 18 feet long and 6 feet in diameter; 33 tons of metal were poured into the mould, but when bored and finished off, it will weigh about 28 tons, or 62,720lb. The great bell of St. Paul's, it may be observed, which is 9 feet in diameter, weighs between 11,000lb. and 12,000lb. Strictly speaking, this cannot be called the largest cylinder in the world, as it has three fellows already in existence of equal size, but we believe that none of similar dimensions have ever before been attempted, or at least accomplished.

The vessel for which they are intended is of proportionably monstrous dimensions. Her length will be 675 feet, her beam 83 feet, and her height 60 feet. A comparison with the *Royal Albert*, which is 272 feet long, 62 feet broad, and 66 feet high, will at once show what a leviathan the new steamer will be. She is built entirely of iron, and is divided into compartments of 60 feet each, perfectly watertight. About 10,000 tons of iron plates will be used in her, and, as each plate weighs about a third of a ton, and is secured by 100 rivets, there will be 30,000 plates, and 3,000,000 rivets employed in her construction. At her bottom these plates are an inch thick: in all other parts but three-quarters of an inch. Up to the water-mark she is constructed with an inner and outer skin, three feet apart, each of equal firmness and solidity; and between these at intervals of six feet, run horizontal webs of iron plate, which materially increase the powers of resistance both of the inner and outer skin. By this mode of construction it is calculated the dangers of a collision at sea, such as occurred lately in the case of the *Arctic*, are very much lessened, for, though the outer skin might be pierced, the inner one remaining intact, as it would, except under most extraordinary circumstances, the safety of the vessel would be in nowise endangered. Again, should she be short of ballast, the space between the inner and outer skin can be filled with water, and 2000 tons of ballast in this way at once obtained. When full it is expected she will draw 30 feet of water,—the *Duke of Wellington* draws 27 feet,—when empty 22 feet. Both screw and paddle propellers are to be used, and the cylinders just described are intended for the paddle engine. The screw engines are being made by Messrs. Boulton and Watt. The paddle engines are 1000-horse power, and are fed by 40 furnaces. The screw engines are 1500-horse power, and require 60 furnaces, the paddle wheels are to be 60 feet in diameter. No apportionment has yet been made of the space to be devoted to cargo and passengers respectively, and this will probably depend greatly on the requirements of the traffic, to be ascertained only by experience. There are to be three tiers of cabins, and it is calculated that in each compartment of 60 feet space will be found for 100 cabins, and these will be unusually high—eight feet. In this manner, this monster steamer can carry about 600 first class, and 2000 second and third class passengers. A few such troopships as this would materially lessen the difficulties

of landing a large force in an enemy's country. She is to carry 12,000 tons of coal, sufficient for a voyage round the world.—*Times*, Oct. 28, 1854.

A bare statement of the dimensions of this large ship, scarcely conveys a notion to the majority of minds of its vast size, capacity, and cost. Mr. Gould has jotted down some points of comparison between the ship and Tavistock-square, and these serve to make the idea much clearer. He points out that Tavistock-square consists of 56 houses, and that there are 18 houses on one side, of 25 feet frontage, or 450 feet. It would require nine from the other side of 225 feet, to make the length of the large ship—viz., 27 houses, or equal to 675 feet. Then the houses being 42 feet deep, it would require two houses put together to make the section of the ship, which is 83 feet; so that it would actually require all the houses put together in two rows to make a block the size of the big ship, setting aside the angles cut off in coming to the keel. Again, the inhabitants of the square may be considered eight to a house, or 448 souls; while the ship will some day carry four times or five times as many, say, 2240 or 3000 souls. At any time in winter the 56 houses in the square will probably have 10 tons of coals each, or 560 tons; while the big ship will take nearly 20 times as much, or at least 10,000 tons for its own consumption. To carry the comparison one step further,—the cost of the 56 houses to build would be about 112,000*l.*; the furniture 58,000*l.*, or, 170,000*l.* ready to be inhabited. This ship, it is supposed, will cost 450,000*l.*, or 500,000*l.*—*Builder*, No. 579.

IMPORTANT IMPROVEMENT IN THE MANUFACTURE OF METALS.

Mr. B. L. Phillips, of Coburg-place, Kennington, has made numerous experiments on cast-iron at one of the largest iron-foundries in Birmingham; and the result has been, that the Liquid Purifier, which is used without the smallest danger, is proved to be capable of imparting to the metal superior strength and toughness. At this foundry, the liquid has been introduced at least twenty times into the ladle whilst the iron was running from the cupola. Several bars were made in this way, and others in the ordinary way, both of the same size and metal; on being tested for strength, it was found that the purified iron was fully 16 per cent. stronger. Some pig-iron, prepared in the same way, was afterwards put back in the cupola, and on being re-melted, and cast again into pig, it was found to be further improved. In the cupola the liquid was introduced four times, and was always found to act powerfully upon the metal, which it purifies in the cupola; and when the metal was run into the ladle, there was little to skim from the top. "The fireman asserts," says the *Mining Journal*, "that he clears out the cupola in half the usual time, and with little labour, and that the moulders generally notice the next day that the first three or four shanks of metal drawn mostly partake of the properties of the previous day's operation. Whether introduced into the ladle or into the cupola, the castings made with the liquid are always cleaner, better, and *stronger*. *The price* that Mr. Phillips has fixed for this useful pre-

paration cannot fail to render the adoption of it a source of economy to the trade generally. To the public, also, it will prove very beneficial, by producing good sound castings instead of the many defective ones which the manufacturer is compelled to send out, in consequence of the very bad pig-iron which is now produced from many of the blast furnaces, and in which from 20 to 30 per cent. of cinder and other dross and rubbish is frequently found. We understand it is Mr. Phillips's intention to introduce this liquid into the puddling and blast furnaces: and from what has been shown of the effects in the cupola, where only a small quantity of liquid was introduced, there is little doubt of its success. On behalf of the iron trade generally, we call on all the respectable ironmasters to give it a fair trial, which, we have Mr. Phillips's authority to state, would be done on his part gratuitously, as have been all the experiments he has hitherto made. The originator of the method has received numerous communications from iron-founders, and others in various parts of the kingdom, to all of which we have reason to know he has replied satisfactorily, giving reference to the firms where the experiments above referred to were instituted.

It must not, however, be supposed that the Liquid Purifier is applicable to the manufacture of iron only, as it has already been applied to that of copper and brass also, and has been found, in these cases, to bring up to the surface of the metal in the crucible, or melting-pot (either in or out of the furnace), all the dross and impurities almost immediately, in consequence of which, the castings formed are stronger, tougher, and more compact, and consequently better adapted to boring and turning than when the ordinary mode of fluxing is adopted. It is scarcely necessary for us to say that the influences which will be exerted by such an improvement as this, should it become fully established, will extend to every branch of our manufactures.—*Mechanics' Magazine*, No. 1620.

MANUFACTURE OF IRON.

In a lecture delivered at the Royal Institution, by Mr. Noad, he states:—Of the various ores of iron from which the metal is usually procured, the Magnetic Iron Ore produces the best quality. It is found abundantly in Sweden and in the United States of America, and the iron of those countries is consequently of a superior character to most others. The carbonate of iron is, however, the richest of the ores, but it is not nearly so much used as the less productive but more abundant ironstone that is found accompanying coal in most of the coal measures. The association of iron with coal is an important advantage, as it requires about three tons of coal for the production of one ton of iron. The mountain limestone, also, on which the coal strata usually rest in England, is eminently useful as a flux, for which purpose it is mixed with the coal and the iron ore before they are thrown into the furnace. The first process to which the ore is subjected, is that of roasting, for the purpose of expelling the volatile matters, particularly sulphur, the presence of which, in even *small quantities*, greatly deteriorates the quality of the iron.

The furnaces in which the roasted ore is reduced are generally about forty-five feet high and twelve feet in diameter at the broadest part, contracting towards the bottom, where the crucible that holds the melted metal is placed. The "tuyeres" or nozzles of the bellows that introduce the blasts of air into the furnace are cooled by being surrounded with fresh supplies of cold water, to prevent their being fused; and the continuous blast is kept up by a steam engine. Dr. Noad stated that the quantity of air consumed in reducing iron ore exceeds in actual weight that of the ore, coal, and flux together, the proportions being seventeen tons of minerals to twenty-two tons of air. As the volume of air required is so immense, its entrance into the furnace tends to diminish the temperature, an effect which is prejudicial to the manufacture of iron. To lessen this cooling influence, the plan of heating the air before it is admitted has of late years been introduced with very beneficial effects. The air is heated by passing it through a succession of hot tubes, and in this manner its temperature is raised to about 600 degrees of Fahrenheit. By the aid of the hot blast, inferior kinds of ore and coals can be employed, which could not be worked by the former method; the good ore yields more abundantly, and the quality of the iron is greatly improved. Mr. Noad stated that the attention of ironmasters is at present much directed to the cinders of the furnaces, which always contain a large proportion of iron, the quantity being greater when the action of the furnace is defective; and it is expected that by improved processes the waste iron may be recovered. In conclusion he alluded to the important improvement which has been introduced of employing the waste gases of the furnaces for heating the blast, and for working the steam-engine. The hot gases, as they pass up the chimney, instead of being allowed to escape directly into the air, are conducted under the boiler of the steam-engine and among the pipes that heat the blast, by which means the fuel previously used for those purposes is entirely saved. It is a striking illustration of the unwillingness shown by our manufacturers to introduce anything new, that the utilisation of the waste gases of the furnace was known and in operation for several years on the Continent before the plan was introduced into this country, and even now it is only partially adopted.

COATING CAST-IRON WITH COPPER.

Mr. W. Newton has patented the Coating Cast Iron permanently with Copper, by depositing the copper by galvanic action, from a solution prepared by first taking a saturated solution of sulphate of copper in water and precipitating with carbonate of potash, and then re-dissolving in cyanide of potassium, whether the copper be deposited directly on the surface of the cast-iron or on zinc previously deposited thereon. The second part of this invention consists of coating cast-iron with brass, by first coating with copper, or zinc, or both, and then depositing the brass thereon, by galvanic

action, from a solution formed by mixing with the solution of copper employed in the first part of the invention, a solution of zinc prepared in substantially the same manner. The iron articles thus coated, may be subsequently coated with gold or silver. Mr. Harris, of Pottsville, Pa. (U.S.), has patented some improvements in rolling railroad iron, which are thus described:—"Instead of the one set of rolls containing the nine grooves, by the new process there are nine separate pairs of rolls, each having but one groove—arranged in one continuous line, with close ducts or boxes between; so that the 'pile' (the hot ball of metal), is fed in at one end, and comes out at the other a railroad bar!" From the specifications of the processes patented by Mr. M. Stirling and Mr. Talbot for the improvement of iron manufacture, it appears that into the moulds, or chills, into which molten iron is run, a mixture of any of the purer oxides of iron, combined with combustible matter, is introduced. Chemical action ensues, and the nature of the pig-iron is changed, so that when afterwards subjected to the process of puddling, it is made ready converted into malleable iron; the quality of which is improved, and may be changed, by the addition of other oxides, salts, &c. The combustible matters employed by the patentees vary according to locality, including ligneous matter, turf, resinous, oily, and fatty matters.—*Builder*, No. 582.

FATIGUE AND CONSEQUENT FRACTURE OF METALS.

At a meeting of the Institution of Civil Engineers, Mr. F. Braithwaite has pointed out the different consequences that will result to masses of metal, according as they are obliged to bear a continuous strain, or one repeated at intervals. In the latter case, a certain disturbance of the particles takes place, the metal becomes sooner deteriorated, and ultimately breaks from the action of the reiterated strain. He contends that, presuming adequate dimensions to have heen given to girders, and the stipulated weight not to have been exceeded, there is not much chance of accident; but any repeated deflection must be productive of danger, which can be averted only by altering or replacing the parts deficient in strength, and maintaining a rigid supervision, whether of beams loaded, of machinery, or of the rolling stock on railways.

PERMANENT EXPANSION OF CAST-IRON BY SUCCESSIVE HEATINGS.

In the Memoirs of the Industrial Society of Hanover for last year, there are some interesting remarks on this question. The remarkable phenomenon that Cast Iron presents on being heated, of not returning back to its original volume, but of continually showing an increase of that volume, and of permanently acquiring an enlarged volume by successive heatings and coolings, was first observed by Rinsep, in 1829. That chemist found that a cast iron retort, whose capacity was exactly measured by the quantity of mercury which it could contain, held at first 9·13 cubic inches; after the first heating and cooling, 9·64 inches; and after three heatings, up to the melt-

ing point of silver, 10·16 cubic inches. The cubical expansion ought, therefore, to be 11·28 per cent., which gives 3·76 per cent. nearly of linear expansion.

At subsequent periods, different phenomena were observed, more or less confirmatory of this law. The cast-iron bars of grates, where powerful fires were made, were frequently observed to elongate, so as to become jammed tight in their frames, and when these obstructed all further enlargement, the bars became curved or twisted. M. Brix, in his work on the calorific power of the fuels of Prussia, has detailed a few experiments on this subject. By the aid of several measurements, he has shown that the entire permanent elongation increases after each successive heating, but that the amount produced by each heating diminishes the more frequently the bar is heated, until it finally becomes insensible. Thus, a furnace bar 3½ feet long, after being three days exposed to a moderate fire, had already acquired a permanent elongation of $\frac{3}{16}$ of an inch, or ·446 per cent., at the end of seventeen days, 1·042 per cent.; and after thirty days, 2 per cent., but had not yet reached its maximum. Another bar of the same kind, after a long service, had a permanent elongation of 3 per cent.

If it be remembered, that bars while exposed to the fire undergo another temporary elongation, we must agree with M. Brix, that an allowance should be made in a bar which has not as yet been used, amounting to 4 per cent. of its length, for this cause of elongation. The bars must, of course, be sufficiently long to stand between their supports when cool, but it seems that hitherto sufficient room has not been given for this permanent expansion in laying down new bars.

PRODUCTION OF WROUGHT-IRON DIRECT FROM THE ORE.

The following novel plans for the accomplishment of this object have been introduced in the United States. The first process is that of Mr. James Renton, who employs an arrangement of furnace so constructed that the surplus heat from the reducing chamber passes round a series of deoxidising tubes, from which the ore, in a partially calcined state, passes through a funnel-shaped receptacle into the puddling furnace. The flues are so arranged that one mass of fuel avails for the whole process, without exposure of the material to the action of atmospheric air, and the proprietors estimate a reduction of full 20 per cent. in the cost of production, as compared with the old processes. The series of deoxidising tubes are surrounded by the flues in every direction, flanked by walls of fire-brick 4½ inches thick, which are again surrounded by an inclosure of common red brick, 12 inches thick, and the heated products of combustion having given out a maximum producing effect, pass to the chimney shaft in the usual manner. Another process, under Hilton's patent, is now being extensively adopted by Messrs. Davis and Co., of Cincinnati. In this case the ore is pulverized, and mixed with 20 per cent. of carbon, in the shape of common bituminous coal; the mixture is then put *into air chambers* heated by anthracite, from which it passes into the

puddling furnace, heated by the same fuel; and nine blooms of 70 lbs. each have been turned out in 2½ hours. The iron is stated to be of the best description, and has been subjected to the most severe tests —such as making horse-shoe nails, screw bolts and nuts, and other articles, requiring the toughest metal. A third plan is that of the Harvey Steel and Iron Company, of New York, which consists of deoxidizing and desulphurizing the ores of iron, by causing the gases generated in the furnace to act directly in contact with them, when properly prepared, and placed upon suitably arranged tables, to the under side of which a high degree of heat is imparted, enabling them to produce malleable iron at one heat, without rendering the puddling operation a separate, as well as a secondary process, and thus obtaining the most economical results.—*Mechanics' Magazine*, No. 1624.

SEPARATING SILVER FROM LEAD.

At the last annual gathering of the Royal Cornwall Polytechnic Society, Mr. J. A. Phillips, of London, at the request of the chairman, addressed to the Society some observations, in which he stated that one of the most important improvements which had recently been made in the metallurgical art came into operation last year, and is the separation of Silver from Lead by means of zinc. After describing the old process of separation, and the subsequent process discovered by Mr. Pattinson, of Newcastle-on-Tyne, involving several crystallizations and a final cupellation; he stated that still more recently a patent had been taken out by Mr. Parkes for a process by which he separates the silver entirely by one operation. To do this, the alloy of silver and lead is melted in the usual way in a large iron pot. To this a small quantity, a few pounds of zinc per ton, is added, the whole mixed up and allowed to remain a short time. By this means the silver is brought to the surface in the form of alloy with the zinc, and this mixture is subsequently skimmed off and treated for the silver it contains. In order to do this the zinc is first partially separated by oxidation, and the residual alloys afterwards treated in the cupel. In connexion with the purification of metals, he might mention some of his own experiments in regard to tin. The tin from Peru and some other countries contains a large amount of tungsten, or wolfram, which very much depreciate its value. Till recently this tin could only be employed for very common purposes, such as making tin pipes and other things, which did not require tin of good quality. But in analyzing some of this tin he happened to discover a process by which the separation was very easily effected, and this process has been recently patented. It consists in taking impure tin, containing from 5 to 10 per cent. of tungsten (worth 25*l.* per ton less than tin of ordinary purity), granulating it by melting it in a reverberatory furnace, and allowing it to flow into a vessel containing water. This granulated tin is then placed in a pan with common hydrochloric acid, which may be obtained from the soda manufacturers at almost a nominal price. This being heated, hydrogen gas is evolved, and a solution of chloride of tin is obtained. In this operation it is necessary the tin *should be present* in excess; unless it be so a certain

portion of tungsten is dissolved. Should, however, the operation be carried on too far, and a portion of tungsten be dissolved, the addition of a small quantity of impure tin precipitates the tungsten, and chloride of tin, free from tungsten, is obtained. This is turned off into a vat, in which more granulated impure tin is placed, and any arsenic or antimony remaining is there deposited, and a pure solution of chloride of tin is obtained. From this Mr. Phillips has to get the chemically pure tin required, and which is quite as good as the stream tin of Cornwall. Into this bath he puts bars of metallic zinc, which precipitate the tin in a spongy mass, when instead of chloride of tin we get chloride of zinc. The tin thus produced may be fused into bars, or sold as the best tin. The chloride of zinc must be so used as to lower the expense of the whole process. To do this it is precipitated by milk of lime, or common chalk; thus is gotten oxide of zinc, which is largely used as a pigment; and to give it sufficient opaqueness for that purpose, the washed oxide of zinc is heated to redness, when it is found to be equal to the ordinary oxide of zinc obtained by sublimation.

RODEN AND THOMAS'S PATENT IMPROVEMENTS IN ROLLING METALS.

In rolling metals according to the method usually employed, one or more pairs of rolls are connected together, and the piece of metal requiring to be rolled is passed between them, and is then lifted over the top roll, and again passed through the rolls, which operation is repeated till the metal is brought to the required shape or thickness. Another plan consists in stopping the motion of the rolls when the bar has passed through, then reversing the rolls, and putting it through in a contrary direction, by this means saving the trouble of passing the bar over the top roll. In all cases, the rolls revolve in the same direction. Messrs. Roden and Thomas's invention, however, consists in employing two or more pairs of rolls, unconnected with each other, and revolving in contrary directions the one to the other; the two or more pairs of rolls being driven either by the same or by a separate moving power. Thus, when a bar or plate is rolled, it passes through one pair of rolls, and is then moved to the other pair, either in accordance with the present system or by a moveable carriage made for the purpose. The operation is repeated till the required section is obtained.—(For details, with illustration, see *Mechanics' Magazine*, No. 1592.)

THE MINTS OF FRANCE.

France possesses seven Mints; before 1814 there were as many as eighteen, but at that period eleven were suppressed, including the following among others—Bayonne, La Rochelle, Limoges, Nantes, Perpignan, and Toulouse. Each of the existing establishments makes use of a peculiar mark on its coinage to designate the mint in which it is struck. Thus the coins of the Paris mint bear the letter A; Rouen, B; Lyons, D; Bordeaux, K; Strasbourg, BB; Marseilles, MM.; Lille, W. But of these seven, Paris is the only mint

that has kept up an uninterrupted coinage of gold and silver money; and it is only since the copper coinage was re-melted that the provincial mints have evinced any activity.

It is a known fact, that the coinage in France is not undertaken by the State, but by contractors, who are styled Directors of the Manufacture, and who are subjected to a system of superintendence and registration. The State allows them for cost of coinage at the rate of a franc and a half per kilog. of silver (about 2lbs.), and six francs for the same weight of gold. The directors of the mint are required to supply one fortieth of the silver coinage in fractional parts of the five franc piece; that is to say, 25,000 francs worth out of every million of francs. It is thus distributed—5250 francs worth (or about 210*l.*) of 2 franc pieces; 12,250 francs worth (or 490*l.*) of franc pieces; 6250 francs worth (or 250*l.*) of pieces of 50 centimes; and 1280 francs worth (or 50*l.*) of pieces of 20 centimes. The tenth part of the gold coinage is to be in ten franc pieces. The cost of the copper coinage is a franc and a half (about 1s. 3d.) per 10,000 francs worth (or 400*l.*) It is difficult to form an idea of the magnitude of the arrangements of the Paris mint. The results already attained are astonishing; nor less so are those within the reach of its machinery, such as the furnaces, crucibles, rolling-mills, presses, milling and cutting apparatus, &c., which are contained in a comparatively small compass. Two steam-engines of thirty-horse power work the various apparatuses which prepare the strips for feeding the coining presses. Each press, attended by a single workman, strikes off 50 coins per minute, and might be made to work off 60 by slightly increasing the speed. It is calculated that if each press were to strike off 50 coins per minute during twelve hours per day for 300 days in the year, the sixteen presses would produce nearly 3,500,000,000 francs (or 140,000,000*l.*) worth of 20 franc pieces; 1,700,000,000 francs (or 68,000,000*l.*) worth of 10 franc pieces; 864,000,000 francs (or 34,560,000*l.*) worth of 5 franc pieces; 639,360,000 francs (or 25,574,400*l.*) worth of pieces of 2 francs, 1 franc, 50 and 20 centimes; and above 31,000,000 (or 1,240,000*l.*) worth of pieces of 5, 2, and 1 centimes.—*Moniteur Industriel: Mechanics' Magazine*, No. 1627.

WESTLAKE'S PATENT GOLD-MILL AND AMALGAMATOR.

THIS Mill and Amalgamator has been invented by Mr. Westlake's mine-agent, of Newton Abbott, Devon. The machine is intended to crush and amalgamate gold ores, gossans, quartz, &c., at the same time, and at one operation. It consists of iron troughs, or basins, which are made to revolve upon vertical shafts at the rate of about sixty revolutions a minute, by means of the cog-wheels and handle, or by cog-wheels and a drum, round which a driving-band is passed. These troughs, or basins, carry in them two or more heavy rollers, which work on axes capable of moving freely up and down in slots formed in the framework of the machine, so that they are at all times free to press with their entire weight upon the bottoms of the basins, or upon the matters which they contain. These rollers are

driven by the friction arising from the motion of the troughs. The materials to be operated upon are fed into the troughs, together with a portion of mercury, and a quantity of water is supplied by pipes fixed in any convenient position. The sides of the basins are made to slope towards the bottoms, which are precisely of the same breadth as the rollers, so that the materials in the troughs will, of necessity, fall to the bottom, and there be overtaken and crushed by the rollers, which are formed either of stone or of cast-iron, and weigh about three tons each.

The Amalgamator is a separate machine, but is connected to the mill by a shoot, or pipe, which conveys the whole of the ground material in solution into the receiver, where it is compelled to pass through heated and disturbed mercury by a mechanical process, which produces a constant contact of the solution with a new and unbroken surface of mercury; the solution then overflows into a waste shoot in such manner that no quicksilver or amalgam is allowed to escape. The basins are provided with pipes fixed on their sides at intervals, to carry off the waste water and pulverized solution, which is received in troughs fixed below on supports. These pipes can be raised, depressed, or fixed by set screws at any required height. By this arrangement the person in charge of the machine is enabled to draw off the solution in different degrees of fluidity dependent upon the height of the orifices or tops of these pipes above the bottoms of the basins, where the mercury, and heavier, or least pulverized portions of the ore, are always to be found.—(For details, with illustration, see *Mechanics' Magazine*, No. 1617.)

METAL WORKING.

A PAPER has been read to the Society of Arts, on "Ancient and Modern Metal Working and Ornamentation, with some allusion to the newly-discovered Art of Nature Printing," by Mr. W. C. Aitken. After a few remarks on the subject of ornament on metal work generally, and on the objections made to certain kinds of ornamentation in which mechanism had taken the place of hand labour, a description was given of the method adopted for producing a large bronze statue as well as for small castings, such as statuettes, &c. Reference was then made to the beaten work of the ancients and mediævalists, which was somewhat akin to the modern process of stamping, except that in the latter the falling below of the stamp hammer, on which the die was fastened, took the place of the hand hammer. A short account was next given of the modern art of electro-metallurgy; which admitted alike the creation of new and the reproduction of old works of art, at a comparatively small cost. Ornamentation by means of engraving was considered to be an expensive process, and on this account attempts had been made, from time to time, to supersede it, and also the cheaper substitute of chasing. Attention was then directed to a process which had been recently introduced, the practical application of which was due to Mr. R. S. Sturges, who held the patent jointly with Mr. R. W. Winfield. The fact of a soft material imprinting on a harder one an

impress of its form had long been understood. In the early stages of this invention it was imagined the harder the material out of which the design was made, the better for the purpose. Keeping this then imagined requisite in view, the first ornament imprinted was made out of steel wire formed into shape and afterwards tempered; but the result was remarkably indefinite and unsatisfactory. Ordinary thread lace was then suggested and tried with success. It was found that it would sustain a pressure of not less than ten tons, and come out from such a pressure comparatively uninjured, leaving its impress even on so soft a substance as Britannia metal. Subsequently, it was found that the same result was produced on copper, on the compound metal, brass, on German silver, on iron and tin plate, and on what is generally believed to be the hardest metal, steel. It should be stated that the device, whatever that may be, either in perforated paper, thread, lace, or other media, is placed between two sheets of metal, and the whole is then passed through metal rolls. The author then referred to the art of Nature Printing, for which the Austrians had preferred a claim, remarking that the English patent for the ornamentation of metals, which was precisely similar so far as the means employed, was taken out on the 24th of January, 1852. He explained that some time back he had himself taken impressions of a leaf, a flower, a feather, in Britannia or other metal,—from which he had printed direct, except that in some cases he had made a transfer to a lithographic stone, and had multiplied copies by the ordinary process of lithography.

MANUFACTURE OF GOLD PENS.

THE Gold for Pens is rolled into thin strips, about the thirty-second part of an inch in thickness. In this state it is black on the surface, and looks like brass. The first operation is cutting it into stubbs—short pieces pointed and angular at one end, and cut square off at the other; this is done in a die; the stubbs are then run through a machine, and each point is indented for the reception of the real pen points. The next operation is pointing the stubbs. The substance used for points is rhodium, a hard brittle metal like steel, unoxidizable. It is to this metal we wish to direct particular attention.

There are various qualities of it, some worth twelve, twenty, thirty, and forty dollars per ounce, and even 120 dollars have been paid for a superior quality. It is found in the ores of platinum associated with iridium, osmium, and palladium. Iridium is used by some for the points of gold pens, but rhodium is the dearest and best. All of this metal used in the United States comes from the Peruvian or Russian mines, but we have been assured that there is plenty of it in California. It is also found there pure, associated with sands, and requiring no chemical manipulation for its separation, as in the platina ores of the Ural. Our gold seekers in California should direct their attention to this metal, as it is far more valuable than gold. It is of a white glassy steel colour, and in minute roundish particles, like sand: *the round globular* particles are the best for pen points;

in fact, out of one ounce of this metal perhaps not one-seventieth of the granules can be used; the rest are rejected. A fine particle of rhodium is soldered on the indented point of each stubb of gold. The solder is mostly composed of gold, for unless it is gold, ink soon corrodes it, and the rhodium point soon drops off. This is the case with poor pens made by indifferent makers.

After the pen is pointed, it is rolled between rollers with indents in them to save the points until the stubb is drawn out to its proper length and correct thickness. The rolling also makes the gold elastic. Many suppose that gold pens can be re-pointed; but such is not the case, for the heat employed to solder on the point renders the gold as elastic as a piece of tin; the heat changes the relative position of the crystals of the metal—thrusts them out, as it were—and the gold requires rolling or hammering afterwards to give it elasticity—the spring so requisite for pens. This is the reason why old pens cannot be re-pointed. Some makers do not hammer their pens after being rolled; they are never so good. After being rolled they are cut to the proper form in a finish die, then stamped with the name of the maker, and afterwards turned up to the rounded quill form. After this the point is slit with a thin copper disc revolving at a great velocity; the great speed makes the soft metal disc cut the hard metal rhodium; the gold is slit with another machine; therefore to make a slit in each pen it has to undergo two operations. The point is next ground on a copper wheel revolving at a great velocity. This is a very delicate operation, and a good artist gets high wages. After this the pens are "stoned out," that is they are ground down on the inside and out by fine Water of Ayr stones, by hand, on a bench alongside of a tub of water; the stones are long, thin, roundish slips, and the pens have to be operated so as to make one part more thin than another, to give them the proper spring. They are then polished on swift revolving copper rollers and afterwards finished with fine powder and soft chamois skin. Thus, to make a gold pen, it undergoes twelve operations. Inferior pens can be made with less labour, but they soon develope their true characteristics.—*Canadian Journal.*

BATES' PATENT MACHINERY FOR STAMPING AND CUTTING METALS.

MR. L. H. BATES, of Bradford, has patented a very effective arrangement of Machinery for Stamping and Cutting Metal Nuts, and other similar metal articles. In constructing his machinery, he fixes a bed or table on which are arranged two or more dies, face to face, each face being formed to correspond to one-half the exterior shape of the article to be produced, so that when the dies are brought together, a space may be left between them, or between every two of them, exactly corresponding to that shape. He mounts the dies so that they may be capable of motion towards or from each other in suitable guides or grooves, and applies to each of them a spring or other contrivance, by which they may be kept constantly apart from each other, except when brought forcibly in contact by the means about to be described. Each side or edge of *each of the dies* is formed with an angular or cutting edge, so that

when these edges are brought together they may sever that part of a bar of metal from which the nut or article is to be formed, and which will at that time be between the dies. Immediately over the space between the dies when in contact is mounted in suitable guides, so as to be capable of motion upwards and downwards, a punch or stamping instrument, by which the piercing of the hole in the centre of the nut, which is to be afterwards cut with a screw thread, is entirely or partially effected. This punch or stamping instrument is weighted to the extent necessary to enable it to perform effectually its intended purpose. For the purpose of bringing the dies forcibly together, so as to form the nut or other article at the same time that the aperture through, or partially through it is produced, the inventor employs the percussive force due to the descent of the punch or stamping instrument. To enable this force to act on the dies, he applies to each die a lever projecting therefrom, at an angle of upward inclination between the vertical and horizontal, and uses springs to retain the levers in such position to enable them to be more effectually acted on by the falling weighted stamp. To this stamp is attached, on each side, curved or inclined surfaces which, when the stamp is caused to descend, act against the levers on the dies and force the dies together, so as to compress the metal into the form of the nut, and sever the nut from the bar at the same time that the central aperture is formed, as before explained.—(For details, with illustration, see *Mechanics' Magazine*, No. 1611.)

QUAIFE'S PATENT WATCH-MAKING MACHINERY.

WATCH-MAKING is one of those manufactures in which the price of labour has hitherto formed a large element of the entire cost of the production. While horologists have from time to time done so much towards perfecting the construction of watches by successive improvements in escapements and compensations, the makers of these instruments have been still restricted to comparatively tedious and expensive processes. Mr. Quaife, the ingenious inventor of the above Apparatus, is a practical watch-maker, and by applying himself for a series of years to the subject, has succeeded in producing an entirely new System of Machinery, by which the cost of the manual labour expended upon the movement-making and finishing departments will be reduced to about one-fourth of its previous amount. The most characteristic feature of the invention is the use of hollow mandrils, and it is by this that the saving is chiefly effected. We have had watches constructed by Mr. Quaife's machinery submitted to our inspection, with the details of the cost of their construction, and have thus been able to verify the success of the invention.

Beside the adaptation of machinery to the manufacture of watch-cases and movements, Mr. Quaife's invention embraces an improved movement or movements for watches. We shall, however, for the present confine ourselves solely to the movement-making department, for details of which, with illustration, see *Mechanics' Magazine*, No. 1591.

METHOD OF COMMUNICATING A DULL BLACK COLOUR TO BRASS.

According to M. Leykauf, a dull black colour, such as is frequently employed for optical instruments, may be given to Brass, by first carefully rubbing the object with tripoli, then washing it with a very dilute solution of a mixture of one part of neutral nitrate of tin and two parts of chloride of gold, and then wiping off the excess of liquid, after the lapse of ten minutes, with a wet cloth. If there has been no excess of acid, the surface of the metal will have assumed a dull black colour. The neutral nitrate of tin may be prepared by decomposing the perchloride with ammonia, and dissolving the precipitated oxide thus obtained in nitric acid.—*Le Technologiste.*

COMBINATION OF INDIA-RUBBER WITH METALS.

Mr. Charles Goodyear, of St. John's-wood, has patented an invention which has for its object the manufacture of articles of a hard compound, made of India-rubber and sulphur (with or without other matters), subjected to heat. The invention consists in combining with such hard compound, in the manufacture of articles therefrom, thin surfaces of gold, silver, or other metal, exterior to, or interior of, the article of the hard compound. The gold or silver is by preference to be shaped in dies or moulds, and the prepared India-rubber is then to be introduced into such dies or moulds, and thereby moulded in contact with the gold, silver, or other metal; and, in the moulded state, the articles are to be subjected to heat, in order to produce the hardening effect to the India-rubber compound. The forms of the articles which may be manufactured are said to be very various; and each article may be coated either wholly or partially with metal. It is stated that the object of the invention is to obtain the light, strong, and tough properties of the hardened compounds of India-rubber together with the ornamental and other properties of metal, combined in the making of one article.

GALVANO-PLASTIC NIELLO.

Niello, a peculiar style of enamelling, consists in engraving or stamping figures on a plate of silver or gold, and then filling the incised lines, or impressed pattern, with a sort of enamel, differing, however, from true enamel, which is a kind of glass, by being formed of a mixture of the sulphurets of lead, silver and copper. This mixture is of a black colour—hence the name Niello, from nigellum, derived from niger, black—and when melted into the intaglio parts of a plate, gives it somewhat the appearance of an inked engraved copper-plate. A new kind of niello-work has lately been introduced on the Continent, in which, however, the figures are not produced by an enamel of sulphuret of silver, as in the true niello, but by a different coloured metal: thus on a plate of gold may be produced fine engravings, the lines of which are in silver, and so on. * * * Many highly ornamental and useful applications might be made of these processes, especially in the manufacture of church furniture. Instead of simply engraving the name and legend upon pieces of plate presented to persons, it might be put in letters of gold at very little more expense.—*Mining Journal.*

HARDENING OF ENGLISH CAST-STEEL FOR CUTLERY.

AUGUST KIESER, of Issny, in Switzerland, prepares sharp instruments from English Cast-Steel, by immersing the blades of a dark cherry-red heat, into a bath composed of four parts of finely-powdered yellow resin, two parts of fish oil, to which is added, in a very hot state, one part of melted tallow, and allowing them to cool perfectly; after which they are heated without wiping them, and hardened in water in the ordinary way. The blades hardened by this process, according to the *Gewerheblatt aus Wurtemberg*, are more uniformly done than by any other method; at the same time that they are not too much so, or the metal too brittle.—*Builder*, No. 572.

NEW METALS FOR MACHINERY.

MR. J. P. KINGTON, of Lewisham-road, Kent, has patented the combination of tin, copper, and mercury, and use of the same as bearings, or linings of bearings, and for Packings for Machinery. The patentee melts (say) about nine pounds of copper, and adds thereto twenty-four pounds of tin. This combination he allows to cool, and again melts it, and then adds 108 pounds of tin; and when the tin is melted, he adds nine pounds of mercury, and then allows the whole to cool. The patentee does not confine himself to the precise quantities of the metals above given. He claims the combining mercury with tin and copper in the manufacture of bearings and packings for machinery.

MACHINERY FOR MAKING SPIKES.

MR. WOOTTON, of Boonton, New Jersey, has patented the following method. Cut nails are clipped out from metal plates by reciprocating knives, and are not made tapering. They have usually been made with one set of die-rolls, and have not been very perfect, the sides being more or less feathered. By the above improved machinery, square nails and spikes are tapered on all sides, and drawn to a point; this being effected by two sets of die-rolls, the one set forming the Spike with its taper, and the other set takes it from the first, and finishes it smooth and tapering.—*Scientific American.*

NEW NAIL-MAKING MACHINE.

THERE has been set to work at Troy (U. S.) a Machine for making Cut Nails, the peculiarity of which is said to be that it is self-feeding, and will manufacture in a given time about twice as many nails as by any other known process, and that one man (as it is claimed), with a boy, will operate ten machines. There is a waste of only about a quarter of an inch in ten feet. One machine will manufacture from 300 to 350 nails a minute, all perfect in form and finish.

NEW USE FOR FURNACE CINDERS.

A USEFUL invention, for which we are indebted to a Dr. W. H. Smith, of Philadelphia, has lately been the subject of experiments made at Merthyr Tydvil, under the sanction of Lady Charlotte Guest, and other *proprietors* of iron works. Dr. Smith professes to

produce from the scoriæ cast aside from the blast furnaces a variety of articles in daily use—such as square tiles, paving flags, and bottles, the last of which are much stronger, and the annealment more complete than in the common glass bottles, from which, in appearance, they are scarcely to be distinguished. The scoriæ are thrown into a mould before they have time to cool. If it should turn out to be possible to put the furnace cinders to such uses, the invention will be of great importance to all proprietors of blast furnaces.—*Athenæum*, No. 1404.

GRINDING AND TEMPERING STEEL AND OTHER METALS.

MR. J. CHESTERMAN, of Sheffield, has patented several improvements for Grinding, Tempering, Glazing, Brushing, and Buffing Steel and other metallic articles; the hardening and tempering processes applying principally to thin steel, such, for instance, as saw-blades. A flat plate is to be ground on both sides at once by means of an upper and nether grindstone, between which the workman forces and works it while the stones are rotating. The "grinders' complaint" is supposed to be mitigated by this mode of operation, which also enables the workman to stand more erect, and use moderate exercise. To glaze, buff, and brush blades of steel and other manufactured metal articles, the patentee employs similar rollers, formed of soft wood, with emery on the surface, or of buff leather, or bristles, or partly of buff leather and part bristles, or the surfaces may be made similar to those ordinarily employed for glazing, buffing, and brushing. For hardening and tempering, the patentee takes a strip from 10 to 30 feet long, as required, and winds it into a circular cast-iron box. In the side of this case is a slot, through which one end of the steel protrudes. It is then placed in a furnace, red heated, and withdrawn by one workman, while another draws it through a pair of cold steel or stone dies, by which it is hardened, and comes out flat. Shorter and thicker articles are operated on by placing them as they are in a suitable furnace, and then drawing them through the dies.—*Builder*, No. 607.

NEW MODE OF PRODUCING GOLD THREAD.

SEVERAL attempts have been made to gild fine fabrics, such as muslin, by moistening them with neutral chloride of gold, and then exposing them to a stream of hydrogen gas which reduced the gold to the metallic state. This process did not, however, yield good results, and was soon relinquished. According to Barreswil, M. de Pouilly now prepares Gilded Silk Yarn by first coating the threads with copper, and then electro-gilding them. The details of his process are still secret, but the idea deserves attention.—*Bulletin de la Soc. d'Encour.*

METHOD OF COVERING WOVEN TISSUES, PAPER, ETC., WITH METALLIC POWDERS, ETC., BY DUVAL, OF PARIS.

IN order to procure metallic tin as a fine powder, chloride of tin is to be dissolved in water containing a little hydrochloric acid, and slips of zinc placed in it. The tin is gradually precipitated at the

time that the zinc dissolves; the precipitated tin is washed tly, a little acetic acid, or nitric acid, being added to the last ns of water used. In certain cases, a small quantity of proto- e of mercury or nitrate of silver may be added to the tin preci- after it has been washed, in order to communicate to it a silver- ppearance. The more dilute the solution of tin, the finer d is the precipitate of metallic tin. This tin powder is put woven tissues or paper by mixing it with gum arabic or glue. r impregnating the paper or the tissue with the tin salt, and aying it upon a zinc plate, the precipitation of the metallic tin ake place directly in the substance of the cloth and paper. of silver, platinum, bismuth, antimony, lead, gold, copper, ay be used for metallizing according to either of these pro-

er is reduced from the nitrate by a concentrated decoction or t of logwood. The paper or tissue is washed with a very dilute on of the nitrate, and is then placed in contact with a plate d with the logwood extract, or with a piece of cotton cloth ted with it. For economy sake, the paper to be silvered is y coated with a spirit or an oil varnish. The paper or cloth lso be prepared with the extract first, and then washed with lt of silver. If the paper be now dried in an atmosphere con- g some ammonia, the silver is reduced, and may be burnished. , bone, ivory, and leather can be silvered if they are allowed to or a quarter of an hour in a decoction of logwood at the tem- re of 176° Fahrenheit, then removed, wiped, and laid for ten es in a solution of nitrate of silver, and the operation repeated essary. If it is desirable to use the silver as a powder, the te of silver is the best salt to employ; this may be reduced by r copper. Dark or light coloured brass may be obtained in a ently divided state, by taking a cylinder of the proper metal xing it as an axle over a wooden box, and causing it to revolve y in contact with a file which is kept pressed against it by means ring or a weight. The filings thus rapidly produced may be still r divided by grinding them upon a smoothly polished plate of with a muller of glass, or of the same metal as the filings. A mill might also be employed for the same purpose, the base glass and the runner brass. In this way the metal may be d to the most impalpable powder. In order to coat paper, or tissues with this powder, it is to be mixed with gum or and then employed exactly as colours are usually in the manu- e of ornamental papers. The gum, or glue, or varnish, can e printed upon the substance to be coated, and the metallic r then dusted on. To produce a gilded surface, the object is d over with a varnish, and then with chloride of gold, after which laced in contact with a cloth moistened with a solution of green ras. The coating of gold thereby produced is then burnished, will exhibit a perfectly uniform coating of gold. This, or a r process, is also applicable to wood, leather, ivory, horn, &c. hloride of gold may also be reduced by sprinkling the surface ened with the salt with zinc or copper powder; other metals

:ud in Ireland Lord Talbot de Malahide, :nd others, take a most lively interest in In France, Prince Murat has become consisting of the Marquis de la Roche-. men, to carry it out. New foreign · obtained.—*Liverpool Mercury.*

'EAT BISCUIT.

..os;—"For some years past there have ities of dried meat from the southern · it is known under the name of *assayo.* r to that of fresh meat. Another sort of vas, the *Meat-Biscuit*, is generally used ·lthough greatly appreciated at the Exhi-yet entered into general use in Europe. . free from grease, the liquor of which is ·v of syrup, and this is mixed with wheaten · to form a solid paste. This paste is then is pierced with a number of little holes, :ensions of sea-biscuits, and is then baked biscuit is eaten dry, or may be broken, ·imes its weight in water for from twenty-. be seasoned with salt or other things. In ·t, as in America, large quantities of ani-:ly for the sake of their hides, it would be ·ve at a low price either the assayo or the ·a of using the blood of animals killed, :asted without profit, or at best is used ·ccurred to some one. M. Brocchieri had ·ating the blood of our slaughter-houses by ·:ed, and uniting to flour of the best quality ·hich he extracts from it, he makes bread ·ly preserved, and which may be employed ·ups. This preparation contains, according ·the azote of the blood consumed."

· 'ESS OF MAKING BREAD.

·:RTIN, of Paris, have discovered this New .own by experiment at the bakery of the . th the following results:—

·een previously sealed, were taken from ·casion.

·s the flour yielded, before baking, 90 .h, after having been baked, gave a net

·· flour yielded 136 loaves of the same · baked, gave 529lbs. of bread. Thus :as 90 to 136, or about 51 per cent. in · and in weight, as 360 to 529, or above new process.

may also be precipitated in this way upon ivory, horn, &c. We would recommend these processes to those interested in the manufacture of ornamental paper, and ornaments in general, as applicable to a great many useful purposes.—*Le Génie Industriel*, Jan. 1854.

IRON HOUSE BUILDING.

Custom-House for Payta, in Peru.—Great progress has of late years been made in this country, in the construction of iron buildings. They have been adapted to domestic, commercial, and even religious purposes, and exported chiefly, but not exclusively, to our colonies. Dwelling-houses, stores, and churches, have all found their way from this land, to be planted on distant sites, where labour is either less skilled or more costly. Messrs. E. T. Bellhouse and Co., of Manchester, have constructed a Custom-house, intended for Payta, in Peru, and an extensive warehouse, or store, having the same destination. The *Manchester Examiner* gives the following particulars of the Custom-house:—The structure is a quadrangle of 70 feet square, and consists of two principal stories, but is by no means limited to this in height, for there rises from the centre a circular tower, standing on a platform 22½ feet square; and above this, a second round tower, surmounted by a cupola, pierced by a flagstaff, from which floats a union jack, the height from the top of the flagstaff to the ground being 100 feet. The erection is now put together in a temporary manner, so as to give assurance of its being perfect in all its parts. When placed on its intended distant site, it will rest upon several courses of brickwork, with stone blocks beneath the main supports. A cast-iron moulded base runs round the foot of the entire building. The first, or ground story, is 12 feet high, having on each of its four sides six strong iron pilasters, in addition to the one at each angle. The space between the pilasters is filled with corrugated galvanized iron, of the thickness known as No. 16 of the Birmingham wire gauge. The corrugations are vertically arranged, and each 5 inches broad. The front entrance is through a door 6 feet wide, having a window immediately on each side of it, giving access and light to a spacious passage through the building, 13 feet in breadth, there being a similar door and pair of windows at the other extremity of the passage. In addition to the windows lighting the passage, there are four other windows in front, two on each side the entrance, whose height is 8 feet, and breadth 4 feet. The casements open inwards, and have guards of iron rods externally. A cast metal moulded string-course finishes the top of the first story, immediately over which is a balcony, projecting 6 feet 6 inches from the face of the building on each of its four sides. The outer edge of this continuous promenade is protected by a wrought-iron railing, having a casting of the arms of Peru in the centre of each separate piece. On entering the broad passage, there are four rooms branch from it on each side, thus furnishing eight apartments, besides a transverse passage, 6 feet wide, from which rises a metal staircase. On

reaching the second story, the passages are of the same dimensions as those beneath, but the rooms are divided into offices half the size, so there are eight on each side the principal avenue—in all sixteen; and each set has a direct internal communication the one with the other, without coming into the passage. The outer windows are the same in the upper as in the lower story, and the pilasters are also continued from the ground to the top of the second story. There are also neat folding-doors leading to the surrounding balcony. The roof, which is also of corrugated iron, stretches over the walls (if we may so call them) to the extent of 7 feet, forming a verandah above the balcony, so as to shelter it from sun and rain. The verandah is supported by open metal cantlevers, and near its under edge it is strengthened by a cast-iron ornamental drop. On ascending the third staircase, we reach a floor in the roof. From the level of this floor to the springing of the roof, there is a distance of about 5 feet; and the roof, instead of finishing in a ridge or apex, terminates in a platform, 22½ feet square, and this platform is 14 feet above the floor beneath it. The platform is supported by eight strong metal columns, which are square to the top of the second story, but circular in the roof, where they are attached to wooden beams, which constitute the framework of the platform. A moulding of cast-iron forms the boundary of the platform, with ornamental railing; and from the central part rises a round tower, also of corrugated metal, 15 feet in height, and 15 feet diameter. It is strengthened vertically by four upright T irons, and rests on a moulded base, firmly attached to the platform, and to secure it still more firmly, there are four tie-rods within, attached transversely. It is lighted by four windows, and has one door leading to the outer platform, which forms a second balcony, and will be covered with lead. From this tower a large clock-dial will be visible, the works being by Mr. J. Bailey, and it is in course of being put into operation. On the top of this tower is a strong flooring, from which rises a smaller tower, 8 feet 6 inches in diameter, and 9 feet high, terminating with a cupola, surmounted by a cast-iron ornament, having an aperture in its centre, through which is placed a flag-staff, from which waves a union jack. Around the upper tower, which is pierced with four windows, there is also a gallery, protected by hand-railing. The entire height of the building is a little over 77 feet. The partitions between the various rooms and offices are constructed, in the first place, of a timber skeleton; this is covered on each side with boards; then pasted over with paper—on this is a coating of felt; and lastly hung with paper. We understand it is built to the order of Messrs. Gibbs, Bright, and Co., London. These buildings have been executed by Messrs. Edward T. Bellhouse and Co., under the superintendence of Mr. Edward Woods, C.E. The architectural details have been arranged by Mr. Edward Salomons, architect, of Manchester.—*Builder*, No. 578.

House for Australia.—Messrs. W. and P. M'Lellan, of Glasgow, have completed a mansion for Mr. Westgarth, the mayor of Melbourne. We learn from the *Glasgow Commonwealth*, that the

house is one story high, with a 14 feet ceiling. The ground-plan is an oblong square of 70 feet by 30, with a projection of 30 feet by 20, having a large bow to the front, which forms a drawing-room of the entire size, with twelve windows. The main entrance to the building is at the left corner of the front, leading into a vestibule, a lobby, and a square hall in the centre of the house, whence there are doors leading to a dining-room 22 feet by 16, three bed-rooms, two dressing-rooms, pantry, bath-room, with water and other closets. The kitchen will be built behind the house, outside, as is usual in all warm climates, and is reached by a lobby from the centre hall. The walls are formed of cast-iron plates, varying from ¼ to ⅜ inch thick. The whole, when completed, will cost about 2000*l.*, exclusive of freight and fitting-up at Melbourne.

Theatre. — Messrs. Bellhouse and Co. have also constructed a complete iron shell and framework of a spacious portable theatre, for Mr. George Coppin, who has engaged Mr. G. V. Brooke, the tragedian, to perform in the principal towns in Australia. This complete portable theatre of iron, with all fittings and appurtenances, will cost a sum exceeding 4000*l.* The building constructed by Messrs. Bellhouse is 88 feet in length, 40 feet wide, and about 24 feet high from the ground level to the peak of roof. As the floor level of the pit will be sunk about five or six feet below the ground level, there will be considerable altitude in the interior. The walls are of cast-iron, uprights (Bellhouse's patent), and galvanized corrugated iron sheets, No. 18, wire gauge. The roof consists of strong iron principals, having the galvanized sheets bolted thereupon. To the gable end of the buil ing, which forms the front, is attached an ornamental building, arranged as box and pit offices, lobbies, and entrances. A degree of ornamental effect is given to this façade. The pit is very spacious, extending back from the foot-lights to the wall below the boxes to about 54 feet, and being 59 feet across. The gallery for the boxes projects 24 feet from the wall opposite the stage, and 8 feet from the wall on each of the sides of the theatre. This gallery is supported on iron columns and strong framework of timber. Messrs. Bellhouse undertook the complete shell of the building, the ornamental façade, and the principal framework of the interior, and engaged to have the whole on board ship in London in about thirty days from date of contract.

Two Iron Churches have been completed in the building-yard of Robertson and Lister, Glasgow. They are similar in size and general appearance, with the exception that one has got two spires, one on each side, and the other one spire, springing from the centre of the pediment. The chief feature of the front elevation is an arcade of ornamental columns and arches, standing out in bold relief, supporting a pediment and flanked at the sides by massive towers, in which are placed the stairs leading to the galleries. The lower series of columns is roofed by a balcony, forming an open porch, whence access is had to the church and to the stairs of the galleries. The dimensions of each church are 73 feet in length, and 45 feet in breadth. The interior is lighted on each side by a series of circular-headed

windows, each 20 feet in length; and at the back by two large stained glass windows. The vaulted ceiling, supported on cast-iron arched girders springing from iron columns, rises to the height of 40 feet. In the crown of the arched ceiling will be placed iron or zinc perforated gratings for the ventilation. The external roofing is formed of corrugated iron. These churches were preliminarily opened for divine service, before they were shipped.

GRANARIES FOR THE STORING OF CORN.

MESSRS. HUART, the great millers of Cambrai, have patented a peculiar kind of Granary which they have in use for the Storing of their Corn. In this arrangement, the corn fills completely the space in which it is to be preserved, and is kept in constant motion by means of a steam engine. The grain is lifted up and stirred round by means of a helix, and from thence falls upon an apparatus in which, by means of a fan, the chaff-dust and other foreign substances are removed, and the insects and their larvæ destroyed. The corn is then carried back to the same inclosed space again, and the operation from time to time repeated. These granaries are considered to be adapted not only for the preservation of corn in good condition, but for that which is already damaged.—*Le Génie Industriel.*

Mr. W. Bridges Adams has patented the substitution of Grain Reservoirs for the present system of storing. As ordinarily constructed, great uncertainty exists, from damp and mildew, weevils, rats, mice, and other vermin, and the floors are only half or three parts filled, to enable men to go in, turn over the corn, and ventilate it. The patentee proposes to construct tanks of various sizes, either of cast or wrought-iron, manufactured in parts so as to be easily and cheaply conveyed, and set up in any locality, as a remedy for these evils. The tanks may be made to hold from 100 to 2000 quarters of corn, and may be placed above ground or in bricked excavations or cellars, and other places of little value. They would have an opening at top for filling them, and a discharge-pipe at bottom with a valve acting similarly to a water-cistern. In case of wheat or other grain being damp when charged, a current of warm air may be injected by an air pump to carry off the moisture, and carbonic acid or other gas may be injected to kill vermin.

NAVIGATION OF IRON SHIPS.

DR. SCORESBY has made to the British Association a communication entitled an "Inquiry as to the Principles and Measures on which Safety in the Navigation of Iron Ships may be reasonably looked for." He alluded to his previous communications on the deviations of ships' compasses by the influence of the masses of iron in iron ships, and said, that after experiencing much opposition, his views had been fully confirmed by Mr. Archibald Smith, a gentleman who had at command all the records of Her Majesty's ships. The principles for which he contended were:—1. That the magnetism of iron ships in its action on the compass may be represented by a vertical and a horizontal bar swinging round a compass. 2. That changes in

the magnetic distribution and compass action in iron ships do take place. 3. That the changes take place in a ship's magnetism by changes of magnetic latitude. 4. That there are influences in a ship derived from the varieties of form and position (relatively to the compass) of particular masses of iron which may act as natural correctives. 5. That the plan of correcting the deviation on iron ships by fixed magnets is unsafe, and in going to southern regions aggravates the error. 6. That the twisting and straining of the iron materials of a ship will tend to alter the magnetic action on the compass; and 7. That it requires time to effect the changes in a ship's magnetic attraction. Dr. Scoresby said, the results of these principles establish the proposition for which he has long contended, that the magnetism of all iron ships is changeable; and that the iron ships in which the least changes may be expected to occur are those which have been long in use, ordinarily pursuing the same course, and those not making voyages further south than the Mediterranean. In such circumstances an intelligent captain, by observing the changes that take place, may generally have confidence in his compasses. The suggestions which Dr. Scoresby made for diminishing the danger arising from deviations are:—that a standard azimuth compass be placed on a high pedestal where a position of smallest deviation may be found; that a compass be placed at the mast-head for reference to correct errors; and that care be taken on the selection of compasses to have ample directive force on the needle.

A very animated discussion ensued, in which Mr. J. Grantham defended iron ships from the supposed insecurity to which they are liable by the deviations of the compass; and he contended that experience proved there is no more danger in navigating iron ships than wooden ones. He mentioned as an instance of deviation that sometimes occurs from local circumstances, that a captain was completely at fault in consequence of his compass having been affected by the iron tiller of his vessel. When an iron ship had its compasses properly adjusted the deviation was readily corrected. Admiral Beechey said, the best precaution would be to have always an azimuth compass on board, and for the masters to take frequent observations. Mr. Fairbairn observed, that though he is greatly interested in the success of iron ships, he must admit they cause deviations in the compass which, if not corrected, might lead to serious error. He mentioned that he took an experimental voyage in one of the first iron ships that was built, when, owing to the influence the iron had on the compass, the captain, who intended to steer for the Isle of Man, found himself on the coast of Cumberland.—*Athenæum*, No. 1408.

VENETIAN SCREW PROPELLER.

Mr. J. Grantham has read to the British Association a paper "On Mr. Fisher's Venetian Screw Propeller." The object of this Propeller is to prevent the retardation which occurs in an ordinary screw propeller, by the tendency to produce a vacuum at the back of the blades *of the propeller.* To effect this, Mr. Fisher makes slits in the blades

to allow the water to pass through, and thus to supply the place of the fluid which is drawn backward as the screw turns round. These slits give the propeller somewhat the appearance of a Venetian blind, and hence its name. Mr. Grantham said the Propeller had been tried in the Birkenhead Docks with good effect.

REEFING TOPSAILS.

MR. GRANTHAM has read to the British Association a paper "On Mr. Cunningham's Plan for Reefing Topsails." This plan consists of an arrangement by which the yard-arm is made to turn round as it is lowered by a pulley fixed to the mast, and the slit in the centre of the sail through which the rope passes, to effect that movement of the yard-arm, is closed by a sail-cloth valve that preserves the action of the sail intact.

NEW LIFE-BOATS.

A TRIAL of a new Life-Boat has taken place on the canal at Limehouse. The boat was designed by Mr. J. Peake, assistant master shipwright in Her Majesty's dockyard, Woolwich, and was built by the Messrs. Forrest, for the National Institution for the Preservation of Life from Shipwreck. Having been hove keel up, by means of an iron crane, the boat self-righted at once, and freed herself of the water she had thus necessarily shipped in thirty seconds. The rapidity with which the boat emptied herself of the water, by means of self-acting delivering valves, was astonishing. One moment she was full of water—the next hardly a drop remained on her platform. On a trial of the stability of the boat, she bore seventeen persons on her side, to bring the gunwale down, with the tubes shut to the water, and twelve men were required to bring it awash, with the valves open. It will thus be observed, that the self-righting power of the boat has hardly diminished her stability. The trials were in every respect satisfactory. The boat is 27 feet long, and costs, with her necessary gear, about 150*l*. Many similar boats have during the past year been placed by the Shipwreck Institution on various parts of the coast.

NEW VELOCIMETER.

THE object of this instrument is to measure the speed of ships, and the velocity of currents of air and water. Its principle is based on that of the *vena contracta*, which was discovered a century ago by Daniel Bernouilli, and has since been applied by Venturi in the double-cone tube which bears his name.

Mr. Overduyn, a Professor at the Royal Academy at Delt, has invented this Velocimeter, the idea of which is based on the negative pressure, or rather the sucking action resulting therefrom, at the narrow gorge or section, where the two tubes of which Venturi's tube is composed, intersect each other. A tube, constructed on the same proportions as Venturi's, is fixed to the vessel in a direction parallel to its axis, the base of the smaller cone being turned towards the bow. *A hole is made* in the side at the intersection of the cones,

into which a small pipe is fitted. As soon as the vessel is in motion, the negative pressure begins to exert itself, and increases proportionately with the speed of the vessel. All that now remains to be done is to measure with precision this increasing negative pressure, whereby the increasing speed of the vessel is ascertained. This is effected by prolonging the smaller tube into a manometric case, on the plan used by Vidi in the construction of his aneroid barometer. Into this case is *inserted* the tube in which the sucking action takes place. The two ends of the case advance or recede according to the vacuum determined, and this vertical movement of the ends of the case is converted into a horizontal motion by means of a lever, and turns an index-point which marks on a dial the degree of velocity attained. It is almost useless to add, that these results may be turned to further advantage by the addition of a *totalisateur*, whereby the degree of velocity obtained after a given time may be arrived at.

In order to ascertain the velocity of currents in a river, &c., the tube must be immersed in the water, when the dial will show the velocity of the stream, which may be ascertained at any point of its depth by immersing the tube accordingly. Currents of air may be measured in the same manner; but when the double cone-shaped tube is used for this purpose, it should be made of larger dimensions, though always in the same proportions. The sucking action of the tube may be rendered more powerful by enclosing it in a larger tube, care being taken to place the front orifice or mouth of the inner tube in the plane of intersection of the two cones of the larger tube.—*Moniteur Industriel.*

NOVEL MODE OF CONSTRUCTING SHIPS.

M. Lombo-Miraval has called the attention of the Société d'Encouragement to a method of Constructing Ships perfectly novel. According to this system, vessels are made altogether of iron wire and hydraulic cement, and the inventor attributes to them the following advantages:—Great solidity, absolute impermeability, facility of repair in case of shipwreck, perfect stability, by the ballast being fixed to the bottom and forming a part of the frame, and finally, incomparable rapidity of construction. A barque, constructed six years ago upon this system, has been since navigated without requiring any repairs, although it has undergone some rough tests.

NAVAL ARCHITECTURE AND STEAM NAVIGATION.

Mr. Scott Russell has read to the British Association a communication "On the Progress of Naval Architecture and Steam Navigation, including a Notice of the Large Ship of the Eastern Steam Navigation Company." Mr. Russell explained the elementary principles which guide the construction of ships, and condemned the legislative restrictions which, till within the last twenty years, prevented the application of those principles. The old "sea chests," which were constructed with a view to avoid the taxation imposed on ships that were not built of certain shapes, possessed neither the *requisite properties* of stability nor windwardness, and were very

slow; they were built solely with a view to hold the greatest amount of cargo within a given superficies, without regard to the other qualities of a ship. In smuggling and piratical vessels the true principle of ship-building, for acquiring speed, had however been long introduced before the subject was taken up by the British Association, and the wave principle of construction had thus been established by extended experiments on a large scale. A fine concave entrance, instead of a bluff round bow, is now generally admitted to be the best; and, in addition to the shape of the water line, it had been found that length of the body of a ship facilitates its passage through the water, by allowing a longer time for the particles of the fluid to separate. A ship with a fine concave bow, a long body, and a comparatively round stern, Mr. Russell said, cleaves its passage through the water without raising a wave in front to obstruct its course. No steam-ship that is not 180 feet long can be propelled at a speed of 16 miles an hour without a great expenditure of power; and 400 feet is the shortest length for a ship that is intended to be propelled at so high a speed as 24 miles an hour. As an illustration of this rule, it was mentioned that the *Himalaya*, which is 365 feet long, attains the greatest speed for the power employed of any merchant ship. In the construction of large ships, however, the builders were met with the difficulty of not being able to find wood of sufficient size for the requisite strength, since no means have yet been invented of joining pieces of wood together so as to give them the same strength as the whole timber. This want of material of sufficient size was supplied by using iron, for the joints can be made as strongly as the whole plate, or plates of metal of any required size can be rolled for the purpose.

This facility of increasing the size of the material is the principal advantage derived from the use of iron, which affords facilities for constructing ships of any size; and it is of that material that the great ship, now building in London for the Eastern Steam Navigation Company, is to be constructed. Mr. Russell complimented Mr. Brunel for the engineering skill and ingenuity he had displayed in leading the way in the construction of large iron ships; and he alluded to the forebodings of disaster on former occasions, when the *Great Western* and the *Great Britain* were built, which forebodings events had shown to be groundless; and he felt confident that the similar forebodings which some people had expressed of the still larger ship now being built would be equally fallacious. Mr. Russell said he wished it, however, to be understood that he did not recommend the general adoption of such large ships. The size of the ships ought to be suited to the traffic and the distance; but the point he contended for was, that it is only by employing very large ships that steam navigation to distant parts of the globe can be profitably carried on. A steam-ship to Australia, if it were not large enough to carry sufficient coal for the voyage, had to take in a supply over and over again, and at each station the cost of the coal was increased by conveying it to the different stations. Under such disadvantages no freight could pay the cost of conveyance; and in order to remove

them, it was necessary to build a ship of sufficient size to carry a supply of fuel for the voyage out and back again, or equal to circumnavigating the globe. An extremely fine entrance was another of the characters which the large ship now building would possess, so as to enable it to move through the water with the greatest attainable velocity with a moderate amount of steam power. With these advantages it was expected that the ship would accomplish the voyage to Australia in thirty or thirty-three days. It would easily carry six thousand tons, besides its requisite quantity of coal; and would have excellent accommodation for 500 first-class passengers, 600 second-class, and 1000 third-class passengers. It would be 675 feet long, 83 feet in breadth of beam, and 60 feet deep; and though so large that St. George's Hall is small in comparison, it is the smallest size that could do the work required with speed and economy.

Mr. Fairbairn said Mr. Brunel had shown him the plans; and though he had at one time thought a ship of that size would be too large for strength, he had, after examination of the plans, arrived at the opposite opinion. He had now no doubt that the ship would be perfectly strong, and be able to bear a gale of wind without bending. It was built on the same principle as the Britannia Tubular Bridge; and when it was perceived that that mode of structure is able to sustain a bridge without any support in the middle, there could be no doubt that supported as the ship would be by the water, it would under all circumstances be able to bear the strains to which it might be subjected. (See also pp. 37 and 38, *ante.*)

VENTILATION OF EMIGRANT SHIPS.

MR. J. CUNNINGHAM has read to the British Association, a paper "On the Ventilation of Emigrant Ships." The system of ventilation proposed comprises the change of air in the cabins by mechanical action and disinfection, by passing the air through a solution of chloride of zinc. The apparatus for the purpose consists of two fans, which are intended to be kept rotating rapidly by means of a small steam-engine, the power of which would be available for other purposes. In the discussion that ensued, it was observed that no appliances for ventilating emigrant ships could be effective unless they were so placed as to be out of reach of the passengers, who, though at the imminent risk of their lives, would stop up all the openings made for the entrance of fresh air.

NEW DIFFERENTIAL GOVERNOR FOR STEAM ENGINES.

THE exertions which engineers have been recently making, in order to produce greater uniformity in the action of steam-engines, is a natural result of the delicate and important applications to which steam-power is now applied. For this object several ingenious methods have been devised, some entirely dispensing with the original Governor invented by Watt, and others rather improving its application, so as to render its action more continuous and regular. This seems to be the nature of the improvement proposed by *M. Luttgens, of* New York, of which we present a brief notice. In

this regulating apparatus, the connecting rod of the stop for shutting off steam is set going by an eccentric, which is capable of varying its eccentricity according to the action of the Governor.

The regulating portion of this apparatus is applied to the principal axle, which is turned by the main crank. On this principal axle a pulley is fixed, over which a strap passes, that embraces another, which is fastened on a small axle placed above, and parallel to the principal axle. The small axle has a bevel wheel which moves on another fixed to the vertical rod of a conical pendulum, this rod turning in a socket and collar fixed on the framework, which also supports the gudgeons in which the axle turns. Lastly, a pulley of greater diameter than the first is attached to the small axle, and from which proceeds a strap, that sets the whole regulating machinery in motion.

With the ordinary Governor, when the velocity changes, the balls rise or fall, thus closing or opening the throttle valve. The motion of the engine is thus brought back to its normal state; but the balls return very soon to their former position, and the advantage is thus only temporary. This defect seems to be absent in the arrangement of M. Luttgens, because the adjustment of the eccentric to a variation of velocity does not cease until the balls have occupied their proper position in a gradual and continuous manner.

URWIN'S PATENT STEAM-ENGINE.

THIS Engine embraces several improvements, which have been subsequently made by the inventor, and which, from their novel and curious character, are exciting a good deal of attention among engineers. With his present arrangement, the inventor has in view four principal objects, which are undoubtedly of immense practical importance. They are as follows:—First, putting the same steam and water back again into the boiler, not reduced below the boiling point, without the aid of the extra machinery; second, producing a vacuum behind the piston, at both strokes, without the ordinary sized air-pump; third, having the advantage of working high-pressure steam; fourth, having also the advantage of possessing always a clean boiler, in which no deposit of silt, &c., can take place, so that the rapid wear of tubes and boiler surface, arising from the employment of impure or salt water, is obviated. A necessary consequence of the first of these would be that but little, if any, additional water would be required to keep up the supply to the boiler after it was once sufficiently fed, and the quantity of the fuel required by the furnace would, of course, be comparatively small. We have seen the small engine which is constructed by Mr. Urwin, according to his improvements, running, when unloaded, at exceedingly high velocities; thereby proving that notwithstanding the seeming incongruity of his arrangements with the laws which are generally believed to govern the action and condensation of steam, there is much in the present invention which deserves the careful scrutiny of experimental engineers. Undoubtedly, the main principle of the invention

is an excellent one—viz., that of securing a considerable portion of the steam, that fills the cylinder at each stroke, before the passage is opened to the cold-water condenser, in order to return it as water to the boiler at a temperature far above 100°, which is that of the ordinary feed-water of condensing engines.—(The details, with illustration, in the *Mechanics' Magazine*, No. 1609.)

CAUSES OF BOILER EXPLOSIONS.

At the last meeting of the British Association, a communication was read from Mr. Sewell "On Boiler Explosions,"—which gave rise to a discussion on the causes of such explosions, and on the effect of percussion in weakening the strength of iron, in which Mr. Fairbairn, Mr. Roberts, Mr. Hopkinson. Mr. Oldham, and other members took part. Mr. Fairbairn said, that, so far as his experience went, the explosions of boilers generally occur at the moment the engines start; in consequence of the sudden generation of steam by the increased motion given to the water. With respect to the weakening of railway axles by use, he conceived that effect to be produced rather by the continuous bindings of the metal, however small they may be, which give a set to the fibres and increase the liability to break. Boiler-plates are also frequently injured by the operation of punching for rivetting. Mr. Roberts attributed boiler explosions in most instances to the defective construction. He was of opinion that in rivetting boiler-plates the rivets are seldom made large enough, large rivets being much stronger than small ones. Mr. Clay said the crystalline structure of wrought iron acquired by long continued percussion might be restored to the fibrous state by reheating. Mr. Oldham considered it would be of advantage to reheat the axletrees of locomotive engines after they had run for some time, so that the fibrous structure, from whatever cause it was rendered crystalline, might be restored. Mr. Roberts was not disposed to admit that any change is produced in the quality of iron by wear. If the iron were of good quality and perfect at first, it would remain so till it was worn out. He observed that bars of iron are frequently different at their opposite ends, for whilst one is tough the other may sometimes be broken with a slight stroke of the hammer.

Mr. H. Dircks read a paper "On the Prevention of Boiler Explosions." The plan Mr. Dircks proposed is to have a pipe leading from a cistern of cold water pass through the boiler, whilst the stop-cock that opens the passage is to be kept closed by a chain within the boiler, and in which chain one link is made of fusible metal.

In the discussion that took place there was a strong opinion expressed against the use of fusible safety-plugs, which had been generally abandoned, and the proposed modification of them was not considered to be a material improvement on the plan that has been found inadequate and inconvenient.—*Athenæum*, No. 1405.

NEW ENGINES, STEAM, AND AIR.

Mr. Thibbets, of Washington (U.S.), has invented a Steam-Engine, the peculiarity of which is, that it has no boiler, but at each stroke

of the engine a small quantity of cold water is forced through a small generator, consisting of an inner and outer cylinder, the water occupying the space between, and thus becoming heated into steam. A hot-air engine has lately been patented by Mr. Philander Shaw, of East Abington, Massachusetts. The cylinder is an oscillating horizontal one. The air-pump takes in air from the compressor, where it is maintained at 60lbs. on the square inch: from this it is admitted into the tubes. The heater is composed of a series of tubes forming a coil, connected with a perforated rotating top plate, moved round by the vibrating beam. This heater gives time for the air to be heated. The hot air, after acting upon the piston, is employed to feed the fire, thereby effecting a considerable saving in fuel. It is intended to have a stream of cold water circulating through the compressor, so as to carry off the heat of air developed by compression, and thus have the air in as condensed a state as possible when it enters the heater. The engine, it is alleged, has been approved of by several scientific and practical engineers.

GOODLET'S NEW MOTIVE AGENT.

IN a communication to the *Mining Journal* on his patent for "Improvements in Engines to be worked by steam, air, or air and water combined," the patentee says: "You will observe that it is not proposed to create a motive power, but to deal with the powers that be, differently than by the plan hitherto adopted,—that instead of boiling the water for steam, in order to give the water elasticity, I propose to take the elements of water and air in their natural state, and to mix them in a vessel by means of the double acting force-pump recommended in the cases of the locomotive-engine, and in draining and purifying mines. A more effective motive agent will in this way be attained to start the engine in a tenth of the time, with less manual labour than is required to trim the coals and supply the furnaces of steamboats with fuel. You will observe from the specification of a plan of an atmospheric vacuum valve to be fixed to the ends of the cylinder covers of steam, air, or water and air combined engines, to prevent recoil from the vacuum, which necessarily takes place when engines are worked by impulses, and the motive agents cut off during the travel of the piston."

PORTABLE STEAM TRAVELLING CRANE.

AT the Birmingham Institution of Mechanical Engineers, a very interesting paper has been read by Mr. W. Fairbairn, of Manchester, descriptive of a newly-invented Steam Travelling Crane, the construction of Messrs. Dunn, Hattersley, and Co., of that city. The advantages proposed by the new crane were, that the steam-power travels with the traversing carriage, and does not require any longitudinal shafts or bearings, the machine closely resembling the general appearance of the ordinary travelling cranes, commonly used by masons and contractors. The longitudinal way, transverse carriage, and crab, are arranged in the ordinary manner; while the steam-engine and boiler, with the driving gear, are supported

on a platform at one extremity of the transverse carriage, being fixed to it, and travelling with it in a longitudinal direction whenever so required. The Steam Travelling Crane which formed the subject of the paper was designed for the contractors for the Grand Trunk Railway of Canada, Messrs. Peto, Brassey, and Betts, and intended to be employed in the construction of the works of that railway, and is, in effect, a new application of the portable steam-engine. A pair of small direct-acting horizontal high-pressure steam-engines are secured to the main timbers of the traversing carriage, the boiler being constructed for burning wood, the cheapest and most abundant Canadian fuel. The tubes are made of solid copper, without seam or joint, so that the acid from the wood should not corrode them. The engine and boiler, with the driving gear, are protected from the weather by a cabin, constructed of light frame-work, and covered with a corrugated iron roof, so as to render the machinery complete. It was stated at the meeting that the cost of the whole was 550*l.* including the engine and boiler, but exclusive of the timber-work for the frame of the traveller platform and shed over the engine, which were not sent out, and would be supplied in Canada. The estimated expense of the entire could not exceed 650*l.* The crane was intended for lifting 10 tons, and moving that weight in any position; it would, however, take more.—*Builder*, No. 619.

HOW'S ENGINE-ROOM TELEGRAPH.

THE absurd and dangerous methods generally employed for transmitting commands from the captains of steam-vessels to the engineers, have not as yet been superseded by a more rational practice, and any such attempt as the present will consequently be regarded with some interest. The principle of this Apparatus is merely that of communicating by very simple gearing, consisting of a vertical shaft and some wheel-work between a dial on the captain's gangway, and another corresponding dial, furnished with an alarm bell, and placed in a conspicuous part of the engine-room. Every turn of the captain's dial will cause the bell to strike, and thus call the attention of the engineer to the particular signal. The Engine-Room Dial is covered with a case, in which is an aperture large enough to allow only one signal at a time to be seen. Whenever the captain wishes to give directions to the engineer, he moves his dial until he brings round the required signal, the bell strikes, and the engineer, looking up, sees the words of command through the aperture of the engine-room dial.—*Artizan.*

USE OF GUTTA PERCHA AND CAOUTCHOUC MIXED WITH OILS AS LUBRICATING AGENTS.

M. NICKELS has patented a number of mixtures of fats with Gutta Percha and Caoutchouc for Lubricating Machinery. His process consists in rolling these materials into thin sheets, which are placed in a quantity of oil sufficient to cover them, and are then *heated until* they are dissolved, the remainder of the oil and fat *being then added,* and the whole mixture well stirred.

No. 1.—200 lbs. of palm oil		Or No. 2.—200 lbs. of palm oil	
66 „	fish oil	100 „	fish oil
40 „	tallow	15 „	caoutchouc
15 „	caoutchouc	15 „	gutta percha
15 „	gutta percha	230 „	clay or talc powder
No. 3.—*A better kind of Machine oil.*		Or No. 4.—*A better and more fluid oil*	
204 lbs. of fish oil		210 lbs. of fish or other oil	
10 „	caoutchouc	14 „	caoutchouc or gutta percha.
10 „	gutta percha		

—*Rep. of Pat. Inventions.*

STEAM-HAMMERS.

MR. T. SUMNER, of Paterson (U.S.), has patented the means under which he varies the direction of the blow, employing for that purpose a hinged or rocking guide frame for the hammer to descend in, with a lever to direct the descent, which he does not claim. Mr. W. Rigby, of Glasgow, has patented some improvements in Steam-hammers, and Pile-driving machinery, by which he claims the use in those steam-hammers in which the steam is used to raise them only, of a hammer-block, in the form of a ram or plunger, passing through stuffing-boxes, so that on the steam being admitted into the cylinder, its pressure will raise the ram to the required height, and the ram will fall by its own gravity, guided by the cylinder and stuffing-boxes. In those hammers in which the steam is used both to raise and depress the hammer, he claims a method of making the ram work through the bottom only, so that the top of the ram forms a piston for the steam to act upon, both in its ascent and descent.—*Builder,* No. 600.

LUBRICANT FOR MACHINERY.

MR. W. LITTLE, of the Strand, has patented certain improvements in the manufacture of Lubricating Matters. The invention is thus described in the patentee's claim:—"The combination of the coal oil, or a heavier oily product, resulting from the second distillation of bituminous coal, or a matter that will so produce a like oil, with a saponified vegetable, animal, or fish oil, or fat; and whether the coal oil be combined with the vegetable, animal, or fish oil, or fat, after or during the saponifying process; the said composition being intended as a lubricator for machinery.

ROSIN OIL FOR LUBRICATING MACHINERY.

PAYEN and Buran recommend the oil obtained by the distillation of common rosin with from 5 to 10 per cent. of quick-lime, as a good material for greasing machinery. As it is generally slightly acid, even when distilled with lime, it is recommended to add from 2 to 5 per cent. of lime or magnesia to the cold oil, which unites with the free acid, and gives the whole mass the consistence of butter.—*Polytechnisches Centralblatt.*

PULVERIZING MACHINE.

THE machine is for the purpose of Pulverizing Sugar, Gum, and other Substances, which cannot easily be ground without clogging. The inventor, *Mr. Chase,* of Boston, Massachusetts, is a manu-

facturer of confectionary upon a large scale in the United States, and the above is one of a series of machines which he has invented for business purposes.

The machine consists in a novel and ingenious application of stampers affixed to a revolving plate attached to the central shaft, and acting within a circular chamber, or mortar. Within this mortar is a circular dish, which occupies the centre space, and is furnished with projections, or wings, on its edge, which divide that part of the mortar nearest its outer edge into a number of rotative cells, or chambers. In each of these cells one of the stampers is placed. When the machine is set in motion, the stampers and dish are carried round together, and the former are alternately lifted and dropped by means of the gearing and cams placed around the centre shaft. Each stamper thus makes eighty beats, during a single revolution of the shaft. The cells are fed by the hopper through the spout inserted into the side of the mortar, and, having made one revolution, are emptied, through another hole at the bottom of the mortar, into the bolting sieve placed in the chamber beneath the hopper.

There is one peculiarity in the action of the stampers in this machine which deserves notice. The sides of the cells in which the pounding takes place being constantly in motion, the material to be pounded is carried round by them, and pushed along or turned over upon the fixed plate which forms the bed of the mortar. By this action a fresh surface is constantly presented to the blow of the stamper, and the ingredients to be pounded never can get beaten into a hard, compact mass, as is often the case with fixed stampers, and thus a very large amount of their powder is rendered ineffective.

The machine has just been provisionally protected by patent in this country.—*Journal of the Society of Arts*, No. 74.

SUSPENSION-BRIDGE AT CHELSEA.

A SUSPENSION-BRIDGE over the Thames, at Chelsea, is now in course of construction for the Commissioners of her Majesty's Works, under the superintendence of Mr. Page, their engineer. It stands nearly midway between Vauxhall and Battersea-bridges. For the foundations, piles of elm-timber, averaging 13 inches square, are driven at intervals of 3 feet, on an average 28 feet below the bed of the river, enclosed by a strong cast-iron casing, 88 feet in length, and 19 feet in width, with curved cutwaters. This iron case consists of piles and plates driven into the bed of the river—the piles to a depth of 25 feet, and the plates 20 feet below the low-water line. These piles are driven at every 9 feet: the metal is 1 inch thick, and the plates are cast with ribs 6 inches deep, and have projecting pieces arranged to fit into the grooves of the piles: this casing forms the outside of the piers; it rises 7 feet above high-water, and is surmounted by a moulded cast-iron curb. From the depth of the piles and plates below the bed of the river, it prevents the water ever undermining the foundations. The elm bearing piles are cut off at a level of 2 feet above low water, and are securely tied together

transversely and longitudinally, by iron bars, bolted to every pile. The loose ground between the piles is scooped out, and the entire space filled to the top of the piles, with concrete, consisting of five parts of gravel to one part of blue lias lime: upon this concrete, two layers of thick Yorkshire stone landings are bedded, care being taken that no void is left between the under surface of the bottom layer and the concrete, but that the stones shall bear equally over the whole foundations. This forms the floor upon which the towers of the bridge are to be erected.

The towers are of cast-iron columns, 10 inches diameter, firmly braced and tied together, and are to be enclosed in an ornamental casing, partly of wrought and partly cast iron. The space between the frame-work and the cast-iron casing of the piers and foundations will be filled in solid, with concrete, and upon this will be a layer of Bradford landings forming the floors of the piers. The chains will be carried over the towers on saddles, moving on rollers, 6 inches diameter, placed on a horizontal bed, and secured to the abutments by mooring-stones, from which spring strong brick arches, which sustain the weight of the concrete, forming the interior of the abutments. The mooring-stones likewise bear against the side walls, so that the whole weight of the abutments is made effective in counteracting the pull of the chains. The roadway is to be formed of wrought-iron girders placed transversely at every 8 feet of the bridge, suspended to the chain by iron bars 2 inches diameter, and diagonally braced with smaller girders of similar construction, upon which rest the roadway-plates, and upon these the pavement forming the road. The footpaths are to be placed outside the chains, and supported at distances of 8 feet by wrought-iron cantilevers bolted to the transverse girders of the roadway. Between the footpaths and the roadway a wrought-iron girder 6 feet deep, and rising about 3 feet above the roadway, will run the whole length of the bridge, stiffening the roadway, and preventing that tremulous motion to which suspension bridges are so subjected.

On each abutment two ornamental lodges are to be built, in character with the architecture of the towers, and will serve as habitations for the toll-men.

In each tower there are staircases leading from the roadway to the piers, which will serve as landing and embarking places for the passengers by the steam boats.

The following are the principal dimensions of the bridge:—

Length from face to face of the abutments at high-water line	700ft.
Distance from centre to centre of the towers	352
Span of centre opening	348
Deflection of chains	29
Distance between the chains	32
Total width of bridge	47
Headway at the centre of bridge above Trinity high-water mark	21

There is much novelty in the construction of the foundations.—*The Builder*, No. 583.

THE PROPOSED WESTMINSTER BRIDGE.

THIS *Bridge is Gothic* in design, to accord with the Houses of

Parliament, and consists of seven openings. The first arch on each side is 95 feet in span, with a rise of 16 feet from Trinity *datum;* the second 105 feet, with a rise of 17 feet 6 inches; the third, 115 feet 3 inches, with a rise of 19 feet; and the fourth, or centre arch, is 121 feet in span, with a rise of 20 feet. The low water line is 18 feet below Trinity *datum.* On the Surrey side there are also two small land arches. Including these, the whole length of the bridge may be called 914 feet. The width of the bridge will be 85 feet, including the parapet on each side. In the construction of the foundations the engineer proposes to avoid the use of caissons. Screw piles will be driven at intervals of 5 feet from centre to centre, to form the outer line of each pier; iron sheathing will be introduced between these to make an inclosure, and the loose ground is then to be dredged out from within it. Timber piles are then to be driven in over the area so inclosed at intervals of 3 feet one way and 4 feet the other, from centre to centre, and concrete will be filled in between them. On the top will be placed two layers of 6-inch landings and granite slabs, and on these will be built the pier, rising 2 feet above Trinity *datum,* to receive the iron superstructure. The headway in centre opening, 20 feet, will be about 5 feet less than in centre opening of the present bridge, and the roadway, nearly level, will be 10 feet lower. The new bridge will occupy some of the site of the old bridge; and, as it is proposed to use the latter during the construction of the new bridge, part of the width of the latter will be put up first, and this will be made fit for temporary use before the old construction is taken away and the remainder of the new work put up. Our readers will remember that the tenders varied from 305,000*l.* to 201,000*l.*, for which sum the bridge is to be built by Messrs. Mare. The contract for the supply of all the granite required has been taken by the Cheesewring Company.

A correspondent of the *Builder* writes: The submerged portions of the works of this bridge are now being carried on with energy, whenever the low state of the tide allows of it; and even during the night when the tide is favourable, the men are at work, without any means being provided to give them the necessary light to carry on their operations. I would remind the persons who are connected with the undertaking, that during the time that some public works were being executed in Paris, not long ago, the workmen were compelled to work all night. Two stages were erected, one at each end of the works, and opposite to each other, with large lanterns of weather-boarding at the top, and open on the side, towards the works. At some considerable elevation within these the electric-light was employed, combined with very powerful reflectors, and the result was completely successful, the whole works being rendered as light as day. Now, it is particularly desirable for the *safety* of the men employed on Westminster-bridge, to have as much light as possible. The above may be erected at a very small cost, and would materially expedite the construction of the bridge. It might, if quite successful, be used afterwards for lighting the bridge.

PREVENTION OF SHIPWRECK BY LIGHTNING.

COPIES of papers relative to "Shipwrecks by Lightning," as prepared by Sir Snow Harris, and presented by him to the Admiralty, have been published by order of Parliament. A short summary prefixed to the details adduced on the subject gives some interesting information. Some idea may be formed of the destructive effects of lightning. when 280 instances are particularized in which ships of the Royal Navy alone were damaged by "the unsparing action of the electrical discharge." The cases quoted happened, for the most part, between the years 1790 and 1840, and included 106 ships-of-the-line, 70 frigates, 80 sloops and brigs, 2 schooners, 7 cutters, 5 sheer hulks, 5 ships in ordinary, and 5 steamers (2 of iron), thus showing that no class of vessel escaped. The damage or destruction involved the masts, rigging, and sails, including the injury of at least 185 lower masts and 150 topgallantmasts. In one-eighth of the cases the vessels were set on fire by the lightning in some part of the masts, sails, or rigging, and, in some instances, were seriously damaged in the hull. The total loss to the country in material could not have been far short of 150,000*l.* Upon these cases alone, and, taking into account every contingency and the number of ships at sea, it is shown that the public expenditure on account of damage done to the navy by lightning would, on a moderate estimate, be from 7000*l.* to 10,000*l.* a year on twenty-three years of the war, between 1792 and 1815, and from 1000*l.* to 3000*l.* a year upon twenty-three years of the subsequent peace. The loss of life caused by lightning is also very great and very deplorable. Nearly 100 seamen were killed, more than 250 dangerously hurt, and full 200 struck down on the decks, sometimes 20 to 40 at a time. The immediate consequence of all this was occasionally to place the vital interests of the country in considerable peril. *Ex. gra.*, the *Glory*, one of Sir R. Calder's fleet, was crippled by lightning in July, 1805, just before encountering the enemy off Cape Finisterre; the *Guerrière* fought the great American frigate *Constitution*, in 1811, with a mainmast injured by lightning, and the *Duke* was actually disabled whilst in action during the attack on Martinique; in short, within six years (1809 to 1815) no less than 40 sail-of-the-line, 20 frigates, and 10 sloops were so crippled by lightning as to become placed for a time *hors de combat*, and nearly in every case obliged to go into port to refit. The recorded instances as to the effects of lightning in the merchant navy are declared to be quite appalling; at least 18 ships, varying from 300 to 800 tons each, are known to have been totally destroyed by this terrible agency within the last twenty years, and some of the instances adduced are most painful.

The report of the Admiralty goes on to notice the invention of Sir Snow Harris for the systematic use in ships of capacious and permanently fixed conductors of electricity. On the faith of original researches the inventor was led to discard the prevalent notions relative to the nature and operation of the electrical discharge exhibited in the form of lightning, and at length came to the elementary result (*from an immense* induction of facts) that "what we com-

monly call lightning is an explosive form of action of some unknown natural agency when forcing a path, as it were, through matter the constitution of which is such as to resist its progress, as, *ex. gra.*, atmospheric air, glass, pitch, wood, &c., while, in falling upon other kinds of matter, such as the metals, the constitution of which is such as to oppose but a small resistance to its progress, the explosive form of action termed lightning is no longer apparent, but is converted, as it were, into a sort of comparatively quiescent current, the expansive force of which is always in some direct ratio to the resistance offered to it." The dominant law determining the course of a stroke of lightning is altogether dependent on this great truth. All kinds of matter are, in respect of any peculiar specific attraction, alike indifferent to electricity; hence the common notion, which considers and covers up every piece of metal as an attraction, and hence a source of destruction, is a vulgar error. On the contrary, smooth metal is the greatest safeguard against lightning, because, as already shown, it offers but little resistance to the course of lightning, or, in other words, it is the most efficient conductor. Acting on this principle, the system as now applied in her Majesty's ships is as follows:—Lines of metal are incorporated with the several masts throughout their whole length, from the truck aloft to the heel of the lower mast; the lines consist of copper plates, in series of lengths of about four feet, varying from 1½ to 4 inches in width, and from 1-16th to 1-18th of an inch in thickness. These plates are everywhere parallel, and so fixed and arranged as to secure a continuous line of material, calculated to yield to any flexure of spars without disturbing the line of conduction. The plates are secured in shallow grooves, ploughed out of the aft sides of the spars; they are turned round the several mastheads, so as to unite with the metallic lines on the next mast, through the caps in which they are supported; the plates are finally turned round the heel of the lower mast, and rest upon similar plates, which surround and envelope the step; these again unite with other similar lines of metal, connecting all the kelson bolts driven through the keel to the copper sheathing outside the ship. Similar lines of metal pass transversely under the beams from the points of the deck in which the masts are placed to the sides of the ship, and there unite with the iron knees and bolts driven through the planking and framework to the copper expanded on the bottom; these transverse lines of metal unite with the lines of metal on the masts, as they pass into the ship. Thus, the whole fabric may be considered, in an electrical sense, as one uniformly conducting mass, so that when a ship is struck by lightning, the explosive form of action vanishes, and the discharge has unlimited room of expansion or play in all directions. This permanent system obviates all the defects of the old ships' conductors, and is very superior to the partial method of applying small wires, or chains, as rigging, from which it essentially differs. In 1830, the Admiralty ordered Sir Snow Harris's invention to be tested by experiment, and a naval and scientific commission reported unanimously in its favour in 1840. *Further trials* were made to make assurance double sure, but in

1842, the Admiralty resolved to act on the report of the commission; and from that time Sir Snow's plan may be considered as having been fully adopted into the public service, after a general trial of twenty years and upwards. About forty cases are recorded of Queen's ships preserved by Sir Snow Harris's plan, the details of which are interesting, but too long for citation. The saving to the public exchequer upon the few cases recorded could not have been less than 20,000*l.* or 30,000*l.*, on a moderate computation. Private shipowners have begun to adopt the same method, which bids fair to extend abroad. Baron Dupin has attested the merit of the invention; and the Report concludes with the deduction that the Royal Navy is completely secure at all times, and under all circumstances, from the effects of lightning.

LIGHTNING CONDUCTORS FOR SHIPS.

MR. R. B. FORBES, of Boston, has proposed a modification of Sir W. Snow Harris's Conductor. It consists simply in leaving the masts at or near to the eyes of the lower rigging, and coming down by one of the shrouds on each side, by a system of tubes and sockets in connexion with a conductor fixed to the side of the ship. By this process, the interior of the ship is avoided, and a simple yet fixed conductor is applied, by which the electric fluid is carried off; a ship can be fitted as well afloat as on the stocks, and as well loaded as when empty, and the moderate cost brings it within the range of the *general ideas* of shipowners. The usual chain, or link conductor, used in the navy, and in some merchant ships, is good *as far as it goes*, but being very liable to derangement, by reason of the strains and jerks to which it is subject, it is not generally adopted, and does not meet the requirements of a permanent conductor. A copper wire of 1 1-6 of an inch in diameter, is good as far as it goes too, and the same may be said of a wire no larger than a piece of twine, or not larger than sewing silk. A small wire will carry off a small discharge of electricity harmlessly to the mast and ship, but it will fuse in the operation, leaving the mast unprotected. Now, it is desirable to have a conductor permanently fixed to, and incorporated with, the masts and hull of a ship, so that a heavy discharge will be as easily carried off as a small one by a small wire. The conductor which Mr. Forbes has patented will do this if it has sufficient surface, and is thoroughly fitted.—*Scientific American.*

LIGHTNING RODS.

AT a late meeting of the Franklin Institute, Dr. Rand exhibited a model of the form of Lightning Rod proposed by Mr. J. L. Gatchell, and explained that no novelty was claimed for the rod, except the combination in one of all the means which experience and theory had shown to be most effective in producing the required protection. The rod terminates above in a platina point, secured upon a similar point upon the rod itself, and surrounded by a brush or row of copper points (as proposed and applied by Dr. Hare), pointing outwards at an *angle of about 45°*, and secured at their bases into a ball of zinc

screwed or soldered upon the rod; this combination of metals being used to prevent the rusting of the copper. The separate joints of the rod are to be secured by screwing, and pass through glass insulators (not, as the inventor states, from any impression of the practical importance of such insulation, but in deference to the time-honoured prejudices of the people). At the lower end, again, the rod terminates on the level of the ground in a zinc ball, from which a number of copper rods pass down to water. This arrangement being adopted to prevent the rusting off of the rod, which not unfrequently takes place where iron is used just below the surface of the ground.

LIGHTNING CONDUCTOR FOR CHIMNEYS.

MR. NASMYTH has described to the British Association, a Lightning Conductor for Chimneys, which he conceived affords more perfect insulation, and is therefore safer than those in common use. The present practice is to fix the conductor outside the chimney by metal holdfasts, by which means, during severe thunder-storms, chimneys are often damaged by the lightning entering at the points of attachment, and displacing the bricks. In the method of fixing the conductor recommended by Mr. Nasmyth, the metal rod is suspended in the middle of the chimney by branching supports fixed on the top. A conductor of this kind has proved efficient in storms which had severely injured other chimneys in the neighbourhood that were protected in the usual manner. An experience of eighteen years had tested the superiority of the plan.

Professor Faraday, on being called on for his opinion, said that he recommended that lightning conductors should be placed inside instead of outside of all buildings. He had been consulted on that point when the lightning conductor was fixed to the Duke of York's Pillar, and he advised the placing it inside; but his advice was not taken, and the rod was fixed outside, to the great disfigurement of the column. All attachments of metal to or near the conductor are bad, unless there be a continuous line of conduction to the ground. He mentioned the instance of damage done to a lighthouse in consequence of part of the discharge of lightning having passed from the conductor to the lead fastenings of the stones. The practical question for consideration by the Mechanical Section was, how far they could safely run lead between the stones of such a structure, for if it were done partially, leaving a discontinuous series of such metallic fastenings, there would be great danger of the stones being displaced by the electric discharge. When such fastenings are used, care should be taken that they are connected together and with the earth by a continuous metallic conductor. Some persons conceived that it is desirable to insulate the conductor from the wall of a building by glass, but all such contrivances are absurd, since the distance to which the metal could be removed from the wall by the interposed insulator was altogether insignificant compared with the distance through which the lightning must pass in a discharge from the clouds to the earth. On being asked whether a flat strip of copper was not better than a copper rod, Professor Faraday said the shape of the

conductor is immaterial, provided the substance and quality of the metal are the same.

STEAM SUPERSEDED.

An ingenious Swedish mechanician, Mr. P. Lagergren, has invented a new Power-engine, intended to supersede Steam. The moving force is the pressure of the atmosphere, which acts on a vacuum in a copper reservoir connected with two cylinders provided with pistons, as in a common steam engine. The vacuum in the reservoir is produced by the admission of a certain quantity of alcohol and of atmospheric air, each time the machine makes a stroke. Explosive air is hereby produced, is fired at each turn, and instantly burns away; and one of the pistons being at the same time opened, an atmospheric pressure is obtained equal to 15 lbs. on the square inch. This machine is light and simple, and its fuel (alcohol) takes little space.

DIRECT-ACTION SCREW ENGINES.

It is gratifying to find that some, at least, of the engineers of the Royal Navy are not behind others of their class, in effecting improvements in screw propulsion, as the present invention sufficiently proves. The designers of this arrangement do not claim great originality, their object being to bring together the best parts of all the known engines of the most eminent manufacturers, and to arrange them so as to obtain connecting rods of greater length than any heretofore employed in such engines, and so as to admit of easy access to, and removal of, any parts that may become deranged, while the space occupied by engines of their construction will not be greater than that ordinarily necessary. The inventors attach particular importance to the increased length of connecting-rod obtained, believing it to be indispensable to the efficient and easy working of the engine, especially for high velocities.

The cylinders are on the principle of Messrs. Maudslay and Field's double-cylinder direct-action engines for paddle-wheel steam-ships, but are placed horizontally instead of vertically, and with a different arrangement of the working parts, the cylinders having only sufficient space between them for the introduction of the connecting-rod, the T-cross-heads and lower guides being dispensed with, and the pistons attached directly to cross-heads of the ordinary form. In this manner great strength is combined with simplicity, and means of getting at the cylinder glands, guides, &c., while under way, as well as at each of the connecting-rod bearings, are afforded. The air pumps are fitted so as to give easy access to the valves, the pump-rods being worked directly from the piston. The slides, of which there is one for each pair of cylinders, are themselves cylindrical, the interior portion forming the induction pipes, the exhaustion taking place from the exteriors of them. By means of the belt round the slide casings, the required area of steam passage is obtained with a reduced travel of the valve, and a communication between the two cylinders is afforded, and thus the pressures on the two pistons are equalized,

and the injurious effects that might arise through leakage are prevented. The feed and bilge pumps are placed between the cylinders, and worked directly from the cross-head, and the expansion valves are fitted to the end of the slide casing, with the slide-valve passing through its nozzle. The slides are worked by the link-motion, and the arrangement of the starting-gear is such, that the engineer is in direct communication with the stoke-hole, and thus has the engines and boilers both under his control at the same moment. The surfaces favourable to the radiation of heat, and those exposed to friction, are not greater than the corresponding surfaces in existing engines, but are less than in many now adopted for screw propulsion.

The simplification of the arrangement of the working parts of screw engines obtained in this arrangement will be peculiarly favourable to the prosecution of examinations and repairs, giving ample room for these, at every part of the engines, and obviating the necessity of making the cylinders single and of very large dimensions, a practice which it is very desirable to avoid, for large cylinders, when priming to a considerable extent, as is frequently the case, occasion great apprehension and anxiety, and at times cause considerable damage, by bending the piston-rods, splitting the cylinder-covers, &c. &c. We need scarcely add, that these engines will be found peculiarly applicable to all large screw vessels, such as our steam-ships-of-the-line, and the Eastern Steam Navigation Company's monster ship of 10,000 tons burden.—(For details, see *Mechanics' Magazine*, No. 1596.)

NEW REAPING-MACHINES.

ONE of the prizes for Reaping-Machines, offered in connexion with the Manchester and Liverpool Agricultural Society's Show, has been awarded for Mr. Harker's "Patent Reaping and Mowing Machine, for cutting grass, corn, &c., improved and manufactured by the exhibitor." It consists of a circular knife, four or five inches in breadth, with a serrated edge, fixed to a drum or cylinder, which is so large that the knife will cut a breadth of five feet. Inside the drum is the necessary machinery and gearing to give it a horizontal revolving motion, &c. It is fitted with reverse motion, so that the knife can be thrown either to the right hand or the left. When the knife needs sharpening, it can be lowered to a stone fixed within the drum, so that the machine is rendered self-sharpening. There is, too, inside the drum, a small wheel which regulates the knife for the height of the stubble. This reaper is drawn by two horses, in tandem harness; and it may be worked by one man leading the horses. During fifteen minutes the corn reaper cut two roods ten perches. The corn is cut, carried round, and laid in a continuous swath on the other side of the machine. An examination of the swath shows that many of the straws are cut a second time just below the ear, by which, practically, no small quantity of good grain is wasted.

GRIMSLEY'S PATENT BRICK AND TILE MACHINERY.

MR. GRIMSLEY, a sculptor, of Oxford, has patented improved *Machinery for the* manufacture of Bricks, Tiles, Pipes, and Pottery; th

first part of which consists of a mill for grinding or pugging the clay, and crushing any stones or foreign matter that may be mixed with it, in order to render the clay more plastic. The top and bottom of the mill are composed of two fluted conical surfaces, the top cone being inverted; both the upper and under surfaces are free to revolve round a central shaft. Between the top and bottom surfaces and equidistant from them, he mounts one or more fluted conical rollers, which are free to revolve round their axes only. Motion being communicated to either of the surfaces, or to one of the conical rollers, all the rollers are caused to revolve round their axes, and to impart rotary motion to the top and bottom surfaces in a contrary direction. When the top and bottom plates are used, the top surface has apertures to admit the clay, which is fed in through the top frame of the mill, while the under surface has also apertures or perforations through which the clay is pressed by the conical rollers into a receiving-box under the mill, in which there is a scraper or coulter revolving, which presses the clay out of the bottom chamber into the moulds, or through dies fixed at each end of the press, either horizontally or vertically. Or he dispenses with the upper surface, and makes the lower one a fixture, the conical fluted rollers turning upon shafts projecting from a central main shaft, and revolving with it, the clay being pressed through perforations made between the flutes of the under surface. When the clay has been received into the receiving-box, it is pressed by another part of the machinery into moulds, as before described; and as soon as the pressure has been applied by a piston or pistons, a cam or eccentric motion causes the front of the mould first to recede and then to rise up, when the piston further advances, and presses the brick or other article out upon a travelling-bed, which presents itself to the front of the mould, while a wire or other cutter is brought between the brick or other moulded article, and the back of the mould or piston, and thus clears the one from the other.—(For details, with illustration, see *Mechanics' Magazine*, No. 1595.)

NEW MUSICAL INSTRUMENT.

M. ALEXANDRE, the well-known organ manufacturer, has invented, on a large scale, a combination of the Harmonium with the Piano, producing effects which on the latter could never be attempted. By a simple pressure of the knee, for instance, an organ-like prolongation of the tone is obtained, and the volume of sound is trebled with the greatest ease; the tones of various other instruments are also successfully imitated. In a word, this new invention unites the advantages of the harmonium with those of the piano, and avoids the dryness and woodenish tones inseparable from the latter.

MARTIN'S IMPROVED JACQUARD MACHINE.

MR. E. LAFOREST, in a paper read to the Institution of Civil Engineers, after stating the very general application of Jacquard Machines to all ornamental weaving, described the old machine, and the *manner in which* the patterns were produced, by means of *bands of punched cards*, acting on needles, with loops, or eyes,

which regulated the figure. He showed, also, the great wear and tear to which these cards were subjected; indeed, so much, that for the carpet trade, they were often required to be made of sheet iron.

In Martin's new Jacquard Machine, the object had been to substitute for the heavy cards, a sheet of prepared paper, punched with given apertures, like the cards of the old machines, but instead of being a series of pieces $2\frac{1}{4}$ inches wide, laced together, the punched paper formed a continuous band, only $\frac{3}{8}$ of an inch wide, thus so diminishing the bulk, that the weight of the new band, as compared with that of the old cards, was in the proportion of 1 to 11.

The method by which this desirable result had been attained was then explained to be, chiefly by an arrangement, which permitted the four hundred spiral springs on the needles, used in the old machine, to be dispensed with, when, as a consequence, the force and wear and tear due to their resistance would be done away with, and fine and light wires could be made to do the work of strong and heavy ones..

In order to render this clear, one of Martin's machines, with a part of an old machine, and bands of equal numbers of cards, under each system, were exhibited.

The next point demonstrated was, that like the bulk and weight, the cost of the cards, under the new system, would be greatly reduced.

It was shown, that by an improved system of punching machinery, the bands could be cut from a design, previously perforated, at the rate of 3000 cards per hour, and any number of duplicates could be produced with equal celerity; it was also stated, that by these means, when a pattern became fashionable, any number of looms might be set to work on it, in about as many days as it had previously required weeks, under the old system. The price of the old cards was 6s. 9d. to 8s. 6d., and upwards, per 100, for new sets, and 5s. 6d. for recuts; whereas the new paper bands would cost 1s. per 100, and 6d. per 100 for recuts. The comparison of cost of 3000 cards (an average band) would, therefore, stand thus:—

	Cost.			Weight.	Length.
	£	*s.*	*d.*		
3000 cards @ 6s. 9d. per 100	10	2	6	90 lbs.	600 ft.
3000 new bands @ 1s. per 100	1	10	0	$8\frac{3}{4}$ lbs.	63 ft. 9 in.

In reference to durability, it was stated, that a band had been in constant work for two years, although used on a heavy waistcoat piece.

NEW STOCKING-FRAME.

A Stocking-Frame, on an improved principle, has been constructed by Mr. John Goold, of Hawick. The invention is exceedingly simple and ingenious, and what is of importance, the old stocking-frames will only have to undergo not very expensive alteration to adapt them to the improvement, instead of being thrown aside as lumber. By the new method, the movements of the frame *are lessened, the* present circular motion being entirely done away

with. The frame is merely pulled forward and back again, the pressing of the work going on at the same time by a brass rod which passes over the needles as the work is brought forward.

NEW STUFF FOR UPHOLSTERY PURPOSES.

M. P. DUCANCEL, dyer and printer of Amiens, employs the articles made of different materials known by the generic name of Utrecht velvets, such as Thibet satin, and in general all those fabrics in which the pile or surface is in goats' wool, to produce an ornamental cloth adapted for a great many purposes. He applies to the velvet surface, by means of a machine or by blocks, a mordant or size, so as to indicate any desired pattern, and upon this he dusts some fine flocks, exactly as is done in preparing ordinary flock room-papers. The variety of patterns as to forms and colours which may be formed in this way is endless, and some of them are of great elegance and beauty. Stamped velvets, consisting of a pattern stamped with a heated iron, have been already in use, but the effect was not very good, as there was no variety of colours, the patterns being produced by a deadened surface upon a brilliant ground, whilst by the method of Ducancel a fine rich uniform surface is produced, with an endless variety of colours.

ROWLAND'S PATENT LABEL DAMPER.

IN order to contribute towards the removal of the evils arising from the general use of adhesive stamps and gummed tickets, Mr. Owen Rowland has invented and patented a simple and cheap Apparatus, consisting of a small vulcanized India-rubber vessel (or a vessel made of any other flexible material), with a piece of sponge fixed in a holder, inserted in the mouth of the vessel, so that when the latter is squeezed or compressed in the hand, and the neck inserted in water, it fills itself in a few seconds; and whenever, by use or otherwise, the sponge becomes too dry, the vessel is to be gently pressed, and the water will be gradually and perceptibly forced into the sponge, the apparatus at the time being held with its orifice upwards. On withdrawing the pressure the water returns into the vessel, leaving sufficient moisture in the sponge for damping purposes. The damper may be left in any position when not in use, as the water will not of itself run out.

The apparatus is also adapted for absorbing liquids in surgical cases, and for damping copying paper; also for cleaning fine painting, mirrors, &c., as the water is doubly filtered, and therefore free from grit, &c. It would also be found very serviceable for use in schools where slates are used.—*Mechanics' Magazine*, No. 1620.

ARTIFICIAL WHALEBONE.

UNDER the name of *Wallofin*, M. Th. Völker, of Meissen, in Saxony, prepares a substitute for whalebone, now gradually becoming dearer, which has all the elasticity of the natural fish-bone, at the same time that it is not influenced by moisture, so that rods of it may be steeped for any length of time in water without becoming soft. It

may be polished, turned, and bored, and recommends itself especially to umbrella makers by its cheapness.—*Deutsche Gewerbezeitung.*

ARTIFICIAL STONE.

MR. FREDERICK RANSOME, of Ipswich, has patented an invention consisting in the use of baryta, or salts of baryta, or any of the salts of lead, to neutralize the impurities arising from the soda employed when soluble silicate is used in the manufacture of Artificial Stone, and also in exposing such artificial stone to a bright red-heat in a suitable muffle or kiln. The efflorescence which is apt to arise from the stone under variations of the atmosphere caused by the use of impure soda is thus, it is said, materially, if not entirely obviated.

VULCANIZED STONE.

AN invention has been patented for hardening the soft stones of the country. Specimens have been exhibited of great hardness, susceptible of high polish, which preserve a sharp arris, and are stated to be proof against the alternations of our climate, and to withstand, not only the London atmosphere, but even the action of the strongest acids. The proprietors allege that, by a solution, chemically prepared, and laid on with a brush in dry weather, the decay of old buildings may be arrested; and the material acted on, whether stone, compo, or brick, be made perfectly non-absorbent.

The specification says:—"It is proposed (in all cases where it is practicable) in applying any indurating mixtures to enclose the stone or other materials to be operated upon in an air-tight chamber, and exhaust, or partially exhaust, the same, and then allow the indurating substance, whether hot or cold, to trickle down, or flow into the chamber, to fill the vacuum, the effect of which will be that the liquid indurating substance will readily find its way into the pores of the stone or other material, and become incorporated therewith.

"Mixture No. 1.—The composition of this solution is as follows:—56 parts by weight of sulphur, dissolved by the aid of steam heat, or dry heat, in 44 parts of dilute vinegar, or acetic acid, containing 17 parts of acid to 8 of water.

"In preparing indurating mixtures to be applied to the exteriors and interiors of buildings, whether possessing a surface of brick, stone, cement, or plaster, I employ the following ingredients:—Shellac, 14 parts, by weight; seed lac, 14 parts; coarse turpentine, 1 part; pyroligneous spirit, 40 parts;"—and other mixtures.—*Builder*, No. 576.

PERFORATED BRICKS.

THERE have been exhibited to the Institution of Civil Engineers, specimens of Mr. Austin's Perforated Bricks and Blocks, with dove-tailed joints, for straight work and for circular or oval culverts; their merit was stated to consist in imparting great strength and solidity to the work, with the parallel joints, using less mortar or cement, and enabling great speed to be employed in laying the

blocks. The larger perforations were stated to be intended for ventilation, as channels for warmed air, or for passing holding-down bolts, where the bricks were used instead of stone, for masses to resist impact or strain. A simple and effective trough, with a cover, for containing the underground wires of the electric telegraph, was also on the table, and in the ante-room there were several ingenious sewer-grate traps, and other accessories for sewerage works, the invention of Mr. Austin and of Mr. Jennings.

GLASS BRICKS.

MR. SUMMERFIELD, of the Glass-works, Birmingham Heath, has patented the manufacture of Chromatic Glass or Glass-faced Grooved Bricks. By Mr. Summerfield's process, red or other clay can be combined with glass; and this will secure durability, entire resistance to moisture, and give an ornamental appearance to the building. The form of the brick is also, by means of a groove at the side and end, made so as to add greatly to the strength of the erection; the joints by this means being brought close together, and the mortar acting as a dowell from the shape of the groove.

IMPROVED CEMENT.

MR. H. J. D. SCOTT, of Woolwich, has patented the obtaining of more perfect chemical action than heretofore between the constituents of Artificial Cement during their calcination, and thereby to improve its qualities as to colour, plasticity, or tenacity, for moulding purposes, and durability in waterworks. He takes lime, and adds thereto any siliceous compound readily attainable, such as river mud or clay, in proportions dependent on the natural cement or hydraulic lime it is intended to imitate; 35 cwt. of lime and 30 cwt. of the siliceous compound giving good results for ordinary purposes. These substances are to be reduced, either with or without the assistance of water, to an impalpable powder, and mixed intimately together. This compound is then placed in iron moulds, and submitted to hydraulic or other pressure, sufficiently powerful to give solidity to the mass. The cakes thus obtained are removed to a kiln, and subjected to calcination after the ordinary manner of burning cements; the degree of heat to which the cakes are subjected being regulated according to the nature and relative amounts of the constituent substances, but using considerably less fuel, as the lime constituent is present in the state of quick lime instead of carbonate. After calcination, the cakes are reduced to a powder, which may then be packed in barrels ready for the market. The patentee states, that by manufacturing cement in this manner he finds the chemical change effected during the calcination of the constituents of the cement to be more complete and uniform than when the ordinary method is employed. The improvement is due, in his opinion, to the close proximity of the constituent particles produced by the hydraulic or other pressure. In some cases he finds it convenient to add the lime constituent to the siliceous earth in the state of chalk, and to effect the conversion of the chalk into lime by driving

off its carbonic acid during the operation of calcining the mixed materials solidified by pressure. When this plan of operating is adopted, the temperature of the kiln must be greater and the calcination of longer duration, than is required in the process before described; in other words, it must be equal to that at present employed for burning the natural cements of similar composition. The proportions of ingredients preferred by the patentee are from 60 to 65 cwt. of chalk to 30 cwt. of clay, or other siliceous compounds. The claim made is for "The employment of hydraulic or other mechanical pressure in the manner and for the purpose set forth."

CAST MARBLE.

D. EMILE BRAUN is stated to have produced a material adapted to plastic purposes, which affords the same sharpness of outlines as plaster of Paris, is scarcely inferior in whiteness to the finest statuary marble, and even surpasses it in impermeability of surface; being perfectly impervious to wet, and capable of resisting all inclemencies of weather. The inventor has already exhibited several busts and statues of this composition which have been viewed by the sculptors and artists of Rome, who are unanimous in their opinion as to the beauty and value of the material, the fracture of which even presents a crystallized structure. This material is as well adapted for the most delicate objects as for works of colossal size; the former exhibiting the utmost refinement of execution, whilst the latter prove that it is capable of resisting any degree of weight arising from the bulk of the objects themselves.—*Builder*, No. 595.

LIQUID QUARTZ.

MR. H. HARDINGE, of New York, has patented a means of manufacturing Liquid Quartz, or Silex, to be used in the manufacture of certain compositions for ornamental and useful purposes. The inventor claims—1. The introduction of steam under pressure into the pulverized agitated mass, thereby lessening the quantity of boracic acid, or other solvents, heretofore used, thus saving the cost, and rendering the liquid quartz so formed sufficiently cheap to be useful. 2. Condensing the steam or vapour produced in the process, so as to save the particles of liquid quartz that are carried off with the steam in the form of capsules. 3. The introduction of liquid quartz, made by the above process, into various compositions.

FERRO-VITREOUS PORCELAIN.

THE new species of domestic ware, as a lasting substitute for Porcelain, glass, and earthenware, as well as for cooking utensils, and consisting of glass on an iron basis, has been considerably improved, under Paris's patent, so as not only to obviate the objectionable use of arsenic in the preparation of its opaque colours, but also to exhibit a variety of colours in the glass or enamel, or even the clear glass and metal alone. The utensils, it seems, will stand any amount of heat, as well as of hard usage. The ware is now both light and elegant in appearance, as well as cleanly in use. The ancient "secret" of

"malleable glass" would appear to be scarce worth knowing now, with such an invention, except for windows and similar purposes. Even gas-tubing, it is said, is made of the ferrovitreous material; and it is particularly useful as a substitute for all sorts of domestic crockery and glass ware at sea.—*Builder,* No. 594.

SILICA IN THE ARTS.

THE Rev. J. Barlow has read to the Royal Institution a paper on this subject, in which he pointed out that besides insoluble substances such as glass, Silica forms a soluble glass when united with an alkali such as soda alone; this soluble silicate or glass is applicable to several purposes, such as the protection of building stones from decay, occasioned by the sulphureous acid of towns or otherwise, the carbonic acid of the air being regarded as capable of decomposing the *soluble* silicate, leaving the silica as a deposit; but more probably by the conversion of the soluble silicate into an insoluble by its conjunction with lime, magnesia, or other bases in the stone. Another proposed use of this "water-glass" is that of hardening cements, mortars, &c., so as to render them impermeable by water, or waterproof, and acting as a substitute for size in whitewashing, carbonate of lime, mixed with a weak solution of water glass, not being easily removable as whitewash, or when a coat of common whitewash is washed with one of water-glass. The Stereochrome of Fuchs was also explained by Mr. Barlow as an application of the formation of insoluble cement by means of water-glass.

APPLICATION OF SLAG.

DR. ROBINSON, of Newcastle, has patented the conversion of molten Slag into sheets or plates, by pouring it upon an iron or other table artificially heated, where, by rolling or pressing, it may be reduced to any requisite thickness. The plates thus formed are afterwards annealed by being allowed to cool gradually for six or eight days, or less. It is proposed to use these sheets or plates for roofing, covering walls, and other useful purposes; and to cut, perforate, or ornament them as required, by means of suitable elevations and depressions in the rollers.

MATERIALS FOR CONSTRUCTING HOUSES.

MR. WM. PALMER, Brighton, has patented tubes or hollow forms of earthenware or brick-earth, to be used in forming the walls, floors, and roofs of houses, and other buildings. These tubes are placed upright in the walls, and horizontal in the floors, and are formed into beams in both cases by having smaller tubes placed inside them, so as to break joint with the outside tubes. The forms at present proposed are square in plan for the outside tubes, and circular for those inside them; and the four spandril corners between the inside circular and the outside square tubes are filled up with cement. In building walls, the foundation is first made level with concrete. The square tubes are then *placed on* end on the concrete in the right position for

the walls. If the circular tubes used be of the same length as the square ones, the inside of the square tubes is filled up solid, with concrete or otherwise, to half its height; the circular tubes are dropped inside the square ones so that they will stand up half their length above the square ones, and thus ensure the joints between the square and circular tubes being broken throughout; or some other equally effective means is taken to secure this breaking of the joints. The spandril corners are then filled in with liquid cement, and square and round tubes built on consecutively till the top of the wall is reached. The beams for the floors and roofs are constructed on the ground in a similar manner, and then lifted into their place and fixed, touching each other so as to form a continuous floor or roof. For the mode of connecting these beams with the walls, of fixing fillets for wood floors between them, of forming a weather-tight joint where one thickness of tubes only composes the external walls, and of finishing the buildings, we must refer our readers to the specification.

A NEW BRICK-MAKING MACHINE,

RECENTLY patented in America and Europe by Messrs. Sands and Cumming, of New York, and introduced here by Messrs. Nourse and Co., of Cornhill, is thus described. In this apparatus the clay is tempered and the brick moulded at one operation; and it may be operated on by steam, water, or horse-power. The brick-frame contains six moulds: it is placed with a moveable palette-board, on a sliding table in front of the machine; the machinery is then put in gear; the table passes under a series of rectangular funnels, through which the clay passes into the moulds; a stamp descends, pressing them with great force, by which all superfluous water is expelled; the sliding table, with the bricks, again makes its appearance outside, whence the bricks are carried away to be stacked. This is all effected in one revolution of the centre vertical shaft, on which are four blades, set spirally, to act as a screw in forcing down the clay, and four horizontal knives for dividing and kneading it. The pressure can be regulated so as to render the machine suitable for every description of clays. The inventors are practical brick-makers, of thirty years' standing. Their machine, as compared with other more complicated machines, is said to be economical in first cost, and in its working rapid and effectual. It tempers, moulds, and presses the bricks in one operation, and can turn out from 14,000 to 17,000 bricks in a day of ten hours by the united labour of two men and two boys, being equal to from twenty-four to twenty-eight a minute.

NORTON AND BORIE'S TUBULAR TILES.

A NEW kind of Roofing Tile, made on the same principle as the hollow bricks, is now being made. Each tile has four tubes running through it, the effect of which is to effectually prevent the heat of the sun from overwarming the interior of the building, as air is an exceedingly bad conductor of heat. Each tile is locked to the next by means of a kind of groove and flange, so that it is impossible for the wind or

air to blow through, as is often the case with slates. The tubular structure, at the same time that it renders the tile very light, makes it much stronger.—*Artizan.*

LAMINATED BITUMEN.

MM. AUMETEYER & Co., of Paris, have patented an ingenious method of obtaining Bitumen or Asphalte in the form of thin sheets, which is worthy of attention in damp countries. The materials employed are of the best description, such as the asphalte of Seyssel, reduced to very fine powder; and the tar derived from the distillation of asphalte substances, principally from Bastennes. The substances are fused together, and in a fluid state come upon a kind of canvas, or rather fine netting, which immediately passes between two metal drums, placed at any required distances apart, according to the thickness of the sheet of asphalte, by which means it is perfectly laminated. One or both sides of the tissue may be covered in this way. Numerous applications of such a material will at once suggest themselves to every one. For example, it may be employed as a lining for damp walls, by fastening it on with a mixture of white lead, varnish, &c., in drying oil, to which may be sometimes added, a little pitch or tar in very damp places. It may also be employed for the walls or floors of cellars, basements, terraces, arbours, rustic temples, and water reservoirs. When properly made, it admits of being painted with great facility, and may in that way be highly ornamented. In no country would the use of bitumen be attended with more benefit than in Ireland; yet, strange to say, it is scarcely ever employed. This process of the Messrs. Auméteyer, if carried out in these countries, would, no doubt, do away with the difficulties which have hitherto stood in the way of its more general use.—*Bulletin de la Société d'Encouragement*, No. 2.

SAWING MACHINERY.

MR. CHARLES F. PACKARD, of Greenwich, Connecticut, has patented an improvement in certain Machines for Sawing laths, pickets, &c., direct from the log. It consists in the use of a vertical circular or reciprocating saw, and a series of horizontal circular saws, the latter being placed upon one shaft at a suitable distance apart, and the shaft being attached to a vibrating bed operated in such a manner that the horizontal saws will be thrown outward from the carriage and log when these are moved in one direction, and thrown towards the carriage and log when they are moved in the opposite direction. When the horizontal saws are thrown in towards the log, they cut into it the exact distance of the width of the pickets, laths, or whatever stuff they may be cutting, but do not separate them from the log; after they are thrown out when the log carriage has travelled to the end of the way, the vertical cutting saw is thrown into gear or action, and it cuts out the series of pickets or laths from the logs.

PLANING WOOD MOULDINGS.

An improvement has been made in Planing Mouldings, which consists in the combination of feed rollers and stationary cutters, by which the mouldings are planed much faster than by hand—the method of finishing them at present. The rotary moulding machines now in general use do not finish the mouldings smoothly; indeed, the sides are not smoothed at all, consequently neat joints cannot be made of such stuff—but require the hand plane. This machine is designed to finish the work accurately.—*Scientific American.*

STERRY'S PATENT ROPE AND TWINE MOULDINGS.

Mr. George Sterry, of Worcester, has patented a new method of manufacturing Mouldings for cornices, picture-frames, and architectural decorations. Instead of employing wood or plaster, he uses as a basis or foundation, rope, cord, and twine, glued together into a shape nearly approximating to that of the finished moulding; and he completes the moulding and brings it to a sharp-finished edge by applying a composition of whiting, size, and turpentine.

The entire process of manufacture is thus described by Mr. Sterry, in the specification of his patent:—

"I take a number of pieces of rope, cord, twine, or the like, of different sizes, and having marked out on a board, or other flat surface, the form of frame or other article which I desire to produce, I proceed to glue the pieces of rope, cord, twine, &c., together in layers until a rough outline of the frame or other article is produced. I place the larger sizes of the ropes, &c., at the back, and glue on the smaller sizes of cord or twine where the sharp edges of the moulding are to be formed. When the moulding has been brought by these means as near as possible to its intended form, I coat it with a mixture of boiling hot whiting, size, and turpentine, of about the consistency of cream, and allow it to dry. When dry it is again coated with a composition of red lead, white lead, oil, and turpentine, well mixed together, and it is then allowed to stand for a few days until quite dry. It is then again coated with the boiling hot mixture of whiting, size, and turpentine, used thin as milk. I then bring the blunt moulding to a perfect shape in the following manner. I take a piece of thin sheet brass, say about one-eighth inch thick, and having marked on it the section of the moulding to be finished, I cut or file away the brass to that form. I then take some strong whiting and size mixture, of about the consistence of treacle, and lay it warm over the rough moulding, and while still soft I draw the cut brass templane carefully over the moulding, and I continue to do so until the edges of the moulding are formed sharp and perfect. I then allow the moulding to dry, and when dry give it a final coating of red lead and oil, which makes it ready for the painter or gilder. By this process mouldings of almost any sectional form may be produced, possessing great strength and durability, and not liable to crack or open."

PREVENTION OF DRAUGHTS THROUGH DOORS OR WINDOWS.

Mr. J. Greenwood, of Arthur-street West, London-bridge, has patented certain modes of applying India-rubber for the above purposes. In the case of the hanging stile of a door, casement, &c., he proposes two modes of using the india-rubber. 1st. A groove is ploughed in that part of the rebate of the door-jamb or frame against which the edge of the door will press, when closed, and a corresponding groove in the edge of the hanging stile of the door, so that the two grooves form one chamber when the door is shut. A piece of india-rubber is then cut slightly broader than the depth of this chamber, and glued

into either of the grooves; and the projecting part of this strip, passing into the other groove when the door is closed, becomes compressed, and excludes the draught. 2nd. On the stop of the jamb an additional stop, moulded or otherwise, is fixed, containing a groove ploughed along the edge which faces the door at about an angle of 45 degrees with such edge. In this groove a strip of india-rubber is glued, and becoming bent by the closing of the door, shuts out the draught. This strip appears on the face of the door when it is closed. A similar mode to that last described is employed for the sills and meeting-rails of sashes, and the stiles of folding-doors.—*Builder*, No. 612.

BORING MACHINES.

A NEW Boring Machine, of great dimensions, has been made at Glasgow, for one of Mr. R. Napier's engine-shops. It weighs thirty tons, and stands 25 feet high. The height of the entablature of the frame is 15 feet, and the width 14 feet. The frame-work is composed of two upright columns, surmounted by an entablature, below which the wheels which give power to the boring tool are supported on a cross-beam. This tool, which can work at all speeds, from one revolution in 2¼ minutes to sixteen revolutions in 1 minute, is capable of boring a hole in solid iron of 10 inches, or a cylinder of 7 feet diameter; it can take any feed, from 1-40th to 1-8th of an inch per revolution of the spindle, and is capable of boring a hole 7 feet 8 inches in length.

At the Birmingham Institution of Mechanical Engineers, Mr. Samuel H. Blackwell, of Dudley, has described "Kind's Improved Apparatus for Boring." It is stated to be in successful use in the coal mines of Belgium and salt works in France. The bore hole is made larger than usual—about 10 or 12 inches diameter; but a centre core is left solid, of about two-thirds the diameter of the bore hole; and this solid portion is brought up by the boring tool, in cylindrical pieces about a foot in length. These show the formation of the strata bored through, and afford the means of measuring the angle of dip of the strata, and also the direction of the dip, thus preventing useless outlay in sinking pits. Considerable economy is said to be effected in the cost and time of boring, by an improvement in construction, by which the rods are prevented from falling with the heavy chisel, so that a light wood rod can be employed instead of the heavy iron rods.

Mr. E. G. Durham, of Portland, United States, has patented a Drill, in which the lifter is brought into contact with a horizontal plate on the drill-rod, causing it to incline slightly during the upward motion of the bar; and to bite and impinge upon it, and hold it firmly, until it is raised to the position required. As the lifter escapes, the plate again assumes the horizontal position, quits its hold, and falls with the drill. There is also connected with the apparatus a friction-plate, by the action of which the bar is raised completely out of the drill hole; and by increasing or decreasing the friction of this plate, the force and rapidity of the action of the bar is accelerated or diminished, according as circumstances may require.

Mr. Nasmyth proposes to overcome the *vis inertiæ*, by converting

the iron bar, or jumper, into a piston-rod, working in an air-tight cylinder, through a stuffing-box. By this plan, it is conceived that increased force will be acquired; for when the piston is drawn out to the end of the cylinder, the pressure of the atmosphere will force it back again with increased effect. It was suggested at the meeting of the British Association, where Mr. Nasmyth read a paper on the subject, that a similar result might be produced, even more readily, by the employment of vulcanised india-rubber springs. Mr. Nasmyth observed, that any very elastic medium might be made to answer the purpose, but air suggested itself, as affording greater extent of spring.

NEW RULE JOINTS.

Mr. B. Dixon, Summer-lane, has registered a new invention in Rule Joints, which appears to have considerable value. It is called the Solid Back-joint; and its chief advantages are stated to consist in its capability of being made altogether apart from the Rule; in its smaller number of parts, and consequent simplicity; and in being constructed of rolled metal (not cast, as by the old process); while the improved article can be produced at less cost. The chief defect in rules has been the joints, and that if a fracture took place, it was on their hollow sides. Mr. Dixon has altogether obviated that difficulty; and his invention, we think, will be found to answer every purpose intended.—*Birmingham Journal.*

NEW MAIL TUBE.

A Nantes Journal states that M. Gally-Cazalat, a civil engineer, has proposed a new plan of transmitting letter-bags and newspapers for the post-office. It is to establish a Line of Cast Iron Tubes of from 6 to 8 inches in diameter, by the sides of the railways, and to create a vacuum in them by means of machines at the principal stations. The letter-bags being placed in the tubes, would then, by the pressure of the atmosphere, be carried on with immense rapidity. M. Cazalat calculates that the steam-power required to create the void would not be attended with any very great expense; he thinks that it need only be a half-horse power for every five miles. Should the tubes be adopted, the electric telegraph (the inventor anticipates) would be almost superseded, as by means of them despatches could be sent from Paris to Nantes in a few minutes.

NEW WASHING MACHINE.

In reference to a New Apparatus for Washing and Wringing Clothes, and worked either by steam power or otherwise, on a large scale or a small, invented by Mr. John Moseley, the *Birmingham Journal* states, that in an experiment witnessed by its reporter at Birmingham, the machine effectually washed and wrung a miscellaneous collection of foul linen, &c., in a quarter of an hour, which no strong woman could have done in less than a day. The machine "takes in the washing" at one end, passing it under a series of "*dollies*" *working* in a trough of water, and afterwards subjects the

articles to the action of rollers, which act as rubbers; finally turning them out at the opposite end perfectly washed and wrung.—*Builder*, No. 575.

FLAX BREAKER.

JOHN HINDE, of Schenectady, New York, has patented a new form of Flax Breaker. It consists in passing the flax straw between a ribbed or fluted endless apron, and a series of fluted rollers, which have a rolling motion over its surface. The action of this sheet or apron and the rollers, is intended to resemble the action of the human fingers in divesting the material of its woody substance.—*Scientific American*.

SEWING MACHINES.

A PAPER has been read to the Society of Arts, "On Sewing Machines," by Mr. C. T. Judkins. The author stated, that the first attempt at stitching by machinery was made by Mr. Ellis Howe, of Boston, in the United States. He conceived the principle of a stitch made by the use of two threads, worked by means of one needle and a shuttle; but after the expenditure of a great deal of money, it proved an utter failure for want of practical mechanical means for working the needle and shuttle. This was in the early part of the year 1846. From that time until 1851 numerous attempts were made to remedy the deficiency. Collecting specimens of these inventions, the author proceeded to examine in what respect they failed to fulfil the necessary conditions, and detecting their deficiency, at length contrived to produce a practicable working machine, and offered it to the public. This machine was, however, alleged to be an infringement upon the invention of Mr. Howe, inasmuch as his machine consisted in the application of a shuttle in combination with a needle, for the purpose of sewing and stitching. Thus the law, which was passed to protect for a time the monopoly of an inventor, became, in this instance, a clog to improvement. It rejected a desideratum to conserve a nullity. Baffled in this instance, he determined on carrying out a plan for stitching upon quite a different principle, doing away with the shuttle entirely, and forming altogether a different stitch. The machine is composed of a flat iron surface, about twelve inches square, resting on four legs of substantial make and form. From one side of this surface an arm rises erect to the height of about ten inches, and then passes over to the opposite side. From the extremity of the arm descends a moveable bar, to the bottom of which is fixed a needle, the eye being about half an inch from the point, and on the top of the arm, is fixed a reel or bobbin, filled with silk or other thread. Fixed to a main shaft is a wheel turned by a handle, which also can be worked by a treadle, or steam-engine, that gives motion to a lever within the arm, and which moves the vertical needle up and down. Beneath the visible surface, or base, is a second reel of thread supplying another needle, which instead of being straight is circular, and works horizontally, and *consequently at right* angles to its stitching companion, which

descends from the arm. Supposing the thread to be passed through the eye of each needle, and the apparatus set to work, the process is thus performed:—The vertical needle descends and passes through the two pieces of cloth to be united, carrying with it the thread to perhaps half an inch below the under side of the cloth; as the needle rises the thread is left behind in the form of a noose, or loop, through which the horizontal needle passes; the horizontal needle, instantly reversing its motion, leaves a loop, into which the vertical needle descends. Both needles thus progress, making a series of stitches, each stitch being quite fast, even should its neighbour be severed. More than five hundred stitches can be made in this manner in one minute. The closeness and tightness of the threads are regulated by a screw, and as each stitch is of equal tension, a great advantage is secured in the regular appearance of the work. The length of the stitch, by turning a small nut, can be increased or diminished to any degree of fineness, and perfect uniformity secured. The cloth to be worked on is adjusted by an attendant, who with one hand turns the wheel, and with the other guides the cloth forward after each stitch. Sometimes two hands are employed, a girl or boy giving rotatory motion to the wheel, while the other attendant regulates the movement of the cloth. The operative, by his actions, can cause the sewing to be straight, angular, or circular.

"About five years ago we do not believe there were more than three or four Sewing Machines in use in the United States; now they can be counted by thousands. They are found in the factories and in the private dwellings, sewing the coarse bag and the most delicate piece of cambric. These machines, since they were first introduced, have advanced towards perfection with a rapidity that is truly astonishing. So many patents have already been obtained for improvements, that it is very difficult to keep pace with their progress; this is evidence of their importance, and, at the same time, it is a sign that applications of them for various purposes, demand new modifications, devices, and arrangements. A patent has been obtained by Charles Parham, of Philadelphia, for a sewing machine combining two threads, a shuttle and needle, the object of which is to dispense with the shuttle race, in order to obviate the friction attendant on its use, and which, requiring oil to lubricate it, often soils delicate articles. He employs a shuttle carrier, in which the shuttle fits so as to allow it to pass through the loop, but requires no movement independent of the one which is given to the carrier, and which requires no fixed guide to produce friction, excepting on the side which does not come in contact with the threads."—*Journal of Industrial Progress*, Dec. 1854.*

BLEACHING BY STEAM.

At the Hotel St. Nicholas, at New York, from 3000 to 5000 pieces of linen are required to be washed daily. One man and three women perform this apparently enormous labour, with the aid of a

* See, also, the Lancashire and other Sewing Machines described in the "Year-*Book of Facts*," 1854, pp. 123—126.

very simple apparatus. This consists of a cylinder of wood, of about 4 feet in diameter, and 4½ feet long, provided with an axle, and mounted upon a frame, and capable of being set in revolution by means of a small steam engine. The axle is hollow, and is placed in connexion with different pipes, in such a way, that steam, hot and cold water, may be successively introduced into the drum; this being first half filled with water, a trap or hand hole is opened, and from 300 to 500 pieces of linen introduced, and a proportionate quantity of soap and of potash or soda ley. The trap is then shut and the cylinder slowly turned, first in one direction, and then in the other. This alternate motion plunges the linen into the water, then out of it against the walls of the drum. This operation finished, the ley is run off, and steam admitted for about fifteen to twenty minutes, the waste steam being allowed to escape by another pipe. Hot water is now introduced, obtained from the condenser of the engine, and finally cold water, which, by means of a few turns of the machine, completely rinses the goods.

When the pieces of linen have drained, they are introduced into a centrifugal machine, which is made to revolve from 1000 to 1800 revolutions per minute, and in which they are dried in six or seven minutes. They are next suspended upon frames, and introduced into a stove heated by a steam pipe, where they are perfectly dried. —*Victor Meunier*, in *La Presse.*

IMPROVEMENT IN LOOMS.

MR. WILLIAM HENLEY, of New Salem, North Carolina, has patented important Improvements in Looms, applicable alike to hand and power looms, but made chiefly with a view to their application to hand looms. One improvement consists in a certain means of throwing the shuttle; and the other improvement relates to working the harness, both of which derive motion from the lay, so that the swinging of the latter sets the whole of the loom in motion—in other words, by swinging the lay, all the working parts of the loom are moved. In common looms, the shuttle, the lay, and the harness, are worked by their distinct and separate movements. These improvements appear to be of great importance to the linen and muslin trade of Ireland and Scotland.

CONDENSER FOR WOOL-CARDING MACHINES.

MR. WILLIAM H. HOWARD, of the City of Philadelphia, has patented certain improvements in Woollen Condensers. The invention consists in a means of keeping several slivers separate, and effectually preventing long staples becoming entangled when being conducted from the doffer to the condensing apparatus. The spools on which the slivers are wound are so placed in guides that the full spools can be removed and the empty ones substituted without waste of material, or interruption of the work. The doffer roller is divided into sections by spaces, and the lower roll is divided into corresponding sections by discs, so that the long staple of several slivers is conducted forward without ever becoming entangled.—*Scientific American.*

M'GLASHEN'S TREE-LIFTER IN PARIS.

MR. M'GLASHEN has exhibited his invention in the Bois de Boulogne, to their majesties the Emperor and Empress of the French. Mr. M'Glashen first introduced the Flower Transplantor, which is adapted for lifting plants of small size with a compact ball of earth around their roots; he then proceeded to experiment with those forms of the apparatus suited for transplanting shrubs and trees. The apparatus adapted for lifting a 22-inch ball of earth was applied to a plant which was speedily raised out of the ground with its adherent ball, and carried away by men on handspokes. The next size of the apparatus shown, was one adapted for lifting trees with an adherent ball of earth, 4 feet 8 inches long, by 3 feet 5 inches broad. The plant chosen for experiment was a fir tree, 30 feet in height, which, on the application of the apparatus, was speedily raised out of the ground with a fine ball of earth around its roots. The whole of the experiments met with the unqualified admiration of every one present on the occasion. The Emperor was so satisfied with the results that he at once ordered the purchase of the whole of the apparatus which Mr. M'Glashen had taken to France.

MINASI'S IMPROVED ARTIFICIAL INCUBATORS.

MR. CARLO MINASI, of London, has recently applied himself to the study of the processes of Artificial Hatching, and has constructed an apparatus, the success of which is exciting considerable interest among those persons who concern themselves with this exceedingly attractive and important subject. Every one who is familiar with the expedients adopted by M. Bonnemain, of Paris, during the last century, and the processes practised by M. D'Arcet, at the hot mineral springs; and, indeed, every one possessed of a knowledge of the circumstances under which the natural hatching of eggs is effected, will be aware that a steady heat of a suitable temperature, maintained for a certain number of days, and a sufficient quantity of fluid to supply the place of the aqueous exhalations which pass off from the egg during incubation, are necessary to the success of any attempt to produce the chick from the egg, in a healthy and natural condition.

In order to supply these, Mr. Minasi constructs a watertight case or tray of zinc, of about 1 inch in depth, and fills it with water, which is maintained at such a temperature, that a layer of fine sand placed on the upper surface of the case is constantly kept by it at about 107° Fahr. Upon this layer the eggs to be hatched are placed, and covered with a sheet of glass or other suitable substance. In order to furnish the vapour necessary to compensate for the aqueous evaporation from the egg, which, if allowed to proceed to a great extent without any counteracting action, would lead to the destruction of the chick *in ovo*, the inventor arranges in the incubator a number of short tubes, extending from the under side of it to the upper, and reaching above the layer before mentioned, so that atmospheric or other moisture may pass up from beneath *and distribute itself* over the whole of the surfaces of the eggs. The

lamp employed is fitted with certain improvements, also effected by Mr. Minasi, by which naphtha is burned, without the use of a wick, so as to keep up a constant temperature for several weeks without any attention. And in order to economize the heat obtained from the lamp, the former is made to traverse a spiral flue, to the sides of which a portion of it is continually transferred, a minimum quantity passing off through a pipe opening into the atmosphere. The heat transferred to the flue, as just described, is communicated to the water; and by the simple expedient of raising one end of the incubator, a continual circulation of the heated water is kept up throughout it. The under side of the zinc case is corrugated, in order that the chicks which are reared in a chamber, of which it forms the upper part, may the better nestle against it.

We have seen about 150 chicks hatched and reared by this apparatus, from two hours to ten weeks old, which were in an exceedingly good condition. At the first experiment made with the incubator, Mr. Appleyard, of Harrow, marked forty-eight of the eggs placed in it, and from this number, thirty chicks were hatched and reared. When this fact is added to the further one that while the cost of other far less successful incubators is about twenty guineas to every hundred eggs they are capable of hatching simultaneously, Mr. Minasi's will not exceed five guineas, we think there is but little doubt that that gentleman has effected great improvements in a process which will probably become very extensively and profitably practised.—*Mechanics' Magazine*, No. 1600.

CEMENT FOR ENAMELLED WATCH-DIALS.

A CEMENT is extensively manufactured in Vienna, for repairing the Dial Plates of Watches when parts of the enamel chip off. It is rather brittle and is distinguished by its fine white colour, and ready fusibility. From an analysis of Carl Knares, of Stuttgart, it consists of resins, very colourless and very soluble in alcohol, with oxide of zinc. In the specimen examined there was 30 per cent. of zinc white. Attempts to prepare a similar substance led to the following method: —Equal parts of dammara resin and copal, in pieces as colourless as possible, were reduced to a fine powder; to five parts of this mixture two parts of Venetian turpentine were added, and the whole rubbed with as much spirit of wine as was sufficient to make it into a thick paste; three parts of the finest zinc white were then rubbed up with it. The mixture had now the consistence of a ground oil paint; on warming it, until the whole of the alcohol was driven off, the mass was melted; and on cooling, it had exactly the appearance and properties of the original sample of cement. The latter had, however, a slight tinge of blue, whilst in that made in imitation there was a slight tinge of yellow. This was corrected by the addition of a little Prussian blue to the alcohol used in rubbing up the paste, and a perfectly similar product obtained. The same results were obtained by melting the resins together, and adding the zinc white to the mixture in a melted state. The fusion of the resins must be conducted with

the greatest care in order not to colour it. In this case also a slight addition of Prussian blue to the mass is of advantage.—*Wurtembergisches Gewerbeblatt, No.* 35, *Polytechnisches Journal.*

BRILLIANT VARNISH FOR CAOUTCHOUC.

M. Fritz Sollier, of Paris, states that a brilliant Varnish, possessing the suppleness and durability of Caoutchouc itself, may be prepared by melting vulcanised caoutchouc, with constant agitation in an iron pot. When fully liquid, and without waiting until it cools, small quantities of oil of turpentine or of naphtha, or rectified coal tar naphtha, are to be added, until a liquid is obtained, having the composition of one of vulcanised caoutchouc to 15 of the solvent; after which it should be filtered, and a small quantity of ordinary caoutchouc varnish added to it, to give it more suppleness. Two coats of this varnish are to be laid on, and when dry are brilliant in proportion as the solution was limpid and dilute, and the drying made with care, and protected from all dust. Another process of M. Sollier adapted for small objects to be varnished rapidly is the following:—Vulcanised caoutchouc, 1; ordinary caoutchouc, 4; essential oil 28. It is only necessary to dip the small object in this solution, and expose it to the sun, when a very brilliant, supple, and adherent coating of varnish will be obtained.—*Scientific American.*

BERARD'S MACHINE FOR SIFTING COAL.

Although the system of washing coal to separate schist and pyrites, invented by M. Bérard, has been in use in France for the last five or six years, and has also been for some time employed near Newcastle-upon-Tyne, we believe we shall be doing good service by bringing it more prominently under the notice of the Irish public. Nearly all our seams of coal are exceedingly thin, and with the most careful working considerable quantities of shale get mixed up with the coal, thereby lowering very much its value, and even in many cases rendering it all but impossible to coke it. A good deal of pyrites is also found disseminated through many seams of otherwise excellent quality, especially in the Tyrone coal-field. The presence of pyrites, as is well known, renders it very unfit for many purposes, such as the manufacture of iron; and the coke made from it, when employed in locomotives, rapidly destroys the boilers. Many attempts had been previously made to purify the coal of such thin seams, but with little result, the quantities capable of being cleaned in a given time being small and the expense very great. By one of M. Bérard's machines, however, costing about 400*l.*, ten to twelve metrical tons (nearly equal to the same number of English tons) can be cleaned in an hour, or from 120 to 140 tons per day, at an expense of about 10 to 12 centimes per ton, or only about one penny! The quantity of water required to work such a machine is also remarkably small, being only about 2000 gallons per day.—*Journal of Industrial Progress*, No. 3.

ESSENCE OF COAL A SUBSTITUTE FOR OIL OF TURPENTINE.

M. PELOUZE, the son of the distinguished chemist of that name, proposes to use an oily fluid, consisting of a mixture of carbo-hydrogens, especially of benzine, &c., as a substitute for oil of turpentine in painting. He obtains this fluid, which boils from 100 to 168° centigrade, by the distillation of cannel coal, by means of sur-heated steam. This liquid is colourless, very fluid, and completely volatile, leaving no stain upon paper, and is not altered by exposure to the light. It has a penetrating smell, which reminds one of common coal gas, but this entirely disappears when it has evaporated. A number of comparative experiments have been made, with the object of comparing it with oil of turpentine, by a committee of the *Société d'Encouragement* of Paris, all of which have resulted in showing that walls, wood-work, &c., painted with paints made with the essence of coal, dried far more rapidly, and the smell disappeared sooner, than where essence of turpentine was employed. For example, in one case where the coal essence and oil of turpentine were respectively mixed with three times their volume of oil, and employed under exactly similar circumstances, the smell of the essence of coal was completely dissipated at the end of three days, while that part painted with the turpentine mixture had still a strong smell, and was not completely dry. The introduction of such an oil would be of great importance, not only in a commercial point of view, but in a hygienic one also.—*Bulletin de la Société d'Encouragement*, June, 1854.

NEW PROCESS OF TANNING.

ROSWELL ENOS, of Binghampton, New York, has patented a new process of tanning sole leather, which is thus specified:—The hair is first removed from the hides in any usual manner, and the hides thoroughly cleaned in either pure water or in a solution of salt and water. A batch of fifty hides are then placed in a liquor composed by steeping 40lbs. of Sicilian sumach, or 150lbs. of unground native sumach, in 250 gallons of water, and adding to it 25lbs. of salt. The hides are to remain in this liquor from twelve to twenty-four hours, the length of time depending upon the temperature of the liquid and the condition of the hides; the best temperature for the liquid is, perhaps, about blood heat. After the hides have remained during the time indicated in the saline infusion of sumach, the liquor is strengthened by the addition of about 200 gallons of strong oak or hemlock liquor and 15lbs. of salt, and the hides allowed to remain in this strengthened liquor for the space of from twelve to twenty-four hours. The hides should then be withdrawn, and placed in about the same quantity of a strong cold oak or hemlock liquor, containing 20lbs. of salt in solution, and allowed to remain in it for five or six days. They are then withdrawn, and placed in the same quantity of liquor, but this time at a temperature of blood heat, where they are to remain for from five to six days. This operation is to be repeated six or seven times, when the hide will generally be found to be completely tanned. While passing through each stage of this

tanning process, the hides should be repeatedly "handled," as is usually done in other processes. This method is peculiar, and certainly, if successful, has the great advantage that no acid or alkali is used; the tannic acid being made to enter the tissue under the influence of the increased endosmatic action induced by the salt. A dried Buenos Ayres hide can, it is said, be tanned by this process in ninety days; an Oronoco hide requires less time; a green, or market hide, in thirty days; harness, or upper leather, in the rough, twenty days; and calf skins in from six to twelve days.

IMPROVED WINDMILL.

DANIEL HALLADAY, of Ellington, Connecticut, has invented an Improvement in Windmills, consisting in the attachment of wings or sails to rotary moveable spindles furnished with levers; these levers being also attached to a head which rotates with the sails upon the same shaft. Another lever is attached to the head. This is connected to a governor, which slides the head upon the shaft, so as to cause the lever to turn the wings or sails. The necessary resisting surface being thus presented to the wind, uniformity of velocity is attained. The proper regulation of the obliquity of the sails, so as to adapt them to the varying motive force of the atmosphere, is represented by the inventor to be thus secured, without difficulty, to a degree which renders his mill more constantly available than those hitherto employed.—*Scientific American.*

USES OF THE WILLOW.

THE *Cleveland Herald* advocates the importance of cultivating the Willow as a branch of agriculture and commerce in the State of Ohio. It states that, in Northern Ohio, much land lies unoccupied, which, by the rearing of willow, would yield from fifty to one hundred per cent. upon the investment. The uses to which willow is now put in the manufacture of a great variety of articles of domestic use, ornament, and luxury, have created a demand for the raw material which cannot, at fair and reasonable prices, be supplied. From two to three million tons of willow are yearly imported from France and Germany, usually bringing in New York from 100 dollars to 120 dollars per ton; but now, owing to the great consumption, commanding 180 dollars per ton.

SHAVING SOAP.

M. FAIST has published the following analysis of a Shaving Soap of Italian origin, which enjoys well merited reputation:—Fatty acids, 57·14; potash in combination with the fats, 10·39; sulphate of potash, chloride of potassium, 4·22; carbonate of potash, trace; silica, 0·46; water, 27·68. The fat acids possessed the characters of mutton suet. This soap differs from ordinary soaps in its base, consisting exclusively of potash, in being proportionately richer in alkali, the equivalent of potash being higher than that of soda, and finally, in being perfectly neuter, whilst the soaps prepared with an *alkaline ley* are generally alkaline. This analysis shows that the soap

was prepared with commercial potash; but as carbonate of potash does not saponify suet, and only acts upon fat acids, the latter must have been first made from the fat, which may be done by saponifying the fat with about twelve per cent. of slacked lime. The lime soap thus formed may then be decomposed by means of sulphuric or hydrochloric acids, and the fat acids washed from the lime salt, and perfectly saponified with about thirty per cent. of commercial potash at 90°.—*Verhandl. des Nieder-Oest. Gewerbe-Vereins.*

MANUFACTURE OF INK.

A Soluble Prussiate of Potash, is stated to have been made by treating a concentrated solution of yellow prussiate of potash with iodide of iron, containing an excess of iodine. The blue precipitate formed is collected, washed, and dried; it is perfectly soluble in water. The mother liquor is colourless, and contains iodide of potassium. The solubility of this blue in water renders it well adapted for the manufacture of ink. When the iodide of iron does not contain an excess of iodine, the resulting precipitate is white; nevertheless, it rapidly becomes blue in the air, and then becomes soluble in water.

SOLIDIFICATION OF BODIES UNDER GREAT PRESSURE.

Mr. Fairbairn has read to the British Association a paper on this inquiry, which contained the results of a portion of the Experiments conducted by himself, Mr. Hopkins and Mr. Joule, at the request of the Association, and by means of funds supplied for that purpose by the Royal Society. At the last meeting at Hull Mr. Hopkins alluded to these experiments, and then explained the nature of the apparatus invented by Mr. Fairbairn for submitting the substances to be operated on to the enormous pressure of 90,000 lb. on the square inch. In these inquiries the objects kept in view were, to ascertain the exact laws which govern the cohesive strength of bodies in their present physical condition, and how far a knowledge of those laws may conduce to the reduction of the metals and their subsequent solidification under circumstances whereby increased strength and density may be obtained. The experiments commenced with spermaceti, bars of which were cast and left to solidify at the same temperature, but under different pressures. When pressure was applied to these bars, the one that sustained a pressure of 40,793 lb. carried 7·52 lb. per square inch more weight than one submitted to a pressure of 6421 lb., the ratio being in favour of the more strongly compressed bar, in its power of resistance to a tensile strain, as 1 to ·876. It appeared from these experiments that bodies when solidified under pressure have not only their densities greatly increased, but their molecular structure is also materially affected, so as to increase their adhesive power. Still further to elucidate the subject, cubes of exactly one inch were carefully prepared and loaded with weights till they were crushed. The first cube, solidified under a pressure of 6421 lb., was crushed with 213 lb. Tin was then operated on; a quantity of pure tin being melted, and then allowed

to solidify; first, at the pressure of the atmosphere, and afterwar at a pressnre of 908 lb. on the square inch. The same quanti taken from the same ingot was subsequently submitted to a pressu of 5698 lb. on the square inch. The bars, after being solidified a allowed to cool for upwards of fourteen hours, were subjected to t usual tests of tensile strains. From these experiments there w derived, as nearly as possible, the same law or measure of streng in regard to the effects of pressure as obtained from the experimer on spermaceti; for with the same pressures of 908 lb. and 5698 l upon the square inch, the breaking weights were 4053 lb. a 5737 lb., or in the ratio of 1 to ·706, being an increase of nearly or third on the crystallized metal when solidified under about six tim the pressure. From these facts Mr. Fairbairn observed, it is evide that the power of bodies to resist strain is greatly increased wh solidified under pressure; and he said he considered it highly pr bable that the time is not far distant when the resisting powers metals, as well as their densities, may be increased to such an exte as to ensure not only greater security, but greater economy by so dification under pressure. He said he was borne out in these vie by the fact, that the specific gravities of the bodies experimented were increased in a given ratio to the pressure. Spermaceti solidifi under a pressure of 908 lb. on the square inch had a specific gravi of 0·94859; whilst that solidified under a pressure of 5698 lb. h its specific gravity increased to 0·95495. The specific gravity of t solidified under a pressure of 908 lbs was 7·3063; and that solidifi under a pressure of 5698 lb. was 7·3154, which gave ·0091 as t increased density from pressure. There are further experiments progress to determine the law that governs this increase of speci gravity, and to determine the conducting powers of bodies solidifi under severe pressure. Experiments have also been made on su substances as clay, charcoal, and different kinds of timber. Fro the experiments on powdered dry clay, it appeared that a bar of th substance 3½ inches long, and 1¼ inch diameter, after being hammer into the cylinder, so as to become slightly consolidated, was reduc in bulk with a pressure of 9940 lb. on the square inch to 2·958; wi a pressure of 54,580 lb. to 2·3; with 76,084 lb. to 2·288; and wi a pressure of 97,588 lb. to 2·195 inches.—*Athenæum*, No. 1408.

NEW WAR MISSILE.

MR. HAZELTINE, of Harwich, has experimented satisfactoril with a shot or shell (for it may be used charged or not, as circu stances may require,) which is a laterally exploding missile, a was fired from an old 6-pounder brass gun, which, much to t disadvantage of the trial, was one-tenth of an inch over its prop gauge. On this occasion hollow shot were used. The missile construction is a conical ball, about 7 inches long, or nearly twi the diameter of the bore, its sections being one-fifth less area th the gun; 6 ribs about five-sixteenths of an inch thick, placed equal distances on the shot at a slight angle, and extending abo *two-thirds of its* length, fit the gun with the ordinary clearan

and a ring fits loosely at the back of the shot, supported by the 6 ribs; so that whilst the propelling force of the powder is fully used, the resistance of the air to the shot is only four-fifths of an ordinary cannon-ball, as the ring only travels a comparatively short distance. The after-part of the shot is cast hollow, so as to throw the centre of gravity as forward as possible; the distance from the gun to the cliff was about 500 yards; of the 8 shot fired into the cliff, 5 were dug out, and were found to have penetrated some 4 or 5 feet into hard clay, the whole of them having entered point first; and to judge from the holes made, and the peculiar whizzing sound produced, the slight inclination of the ribs seems effectually to have rifled the shot in its flight. The shell upon this principle has a bolt running through its length, so as to render it much stronger longitudinally than laterally; consequently, its effect on entering a ship's side or wall and exploding, must be very destructive. Shells of this kind would be of no little use in the Baltic and Black Seas, as aim may be taken as correctly with them as with a rifle ball, and one of these from a 68-pounder would certainly be a most unpleasant visitor. The weight of the shot used was about 6 lbs. 14 oz., and the charge of powder 1lb.—*Essex Standard.*

VAST CARTRIDGE MANUFACTORY.

MESSRS. SCHLESINGER and HILLS, at their factory at Northfleet, during the past year, have executed a contract from Government to manufacture entirely thirty-five millions of Ball Cartridges for the army in the East. In this manufacture there were employed upwards of 500 men, women, and children. Some of the youngest of the working children were not more than seven years of age. The busy scene is thus described by a visitor:—"These children are employed in making envelopes in which the cartridges are wrapped prior to packing; the women and children are employed chiefly in rolling up the paper cartridge cases, which are made of what is called shorthand, or whitey brown paper, and not 'cartridge paper,' and putting the bullets into them; such persons are paid piece-work, and earn from 7s. to 10s. per week. These cases are passed into other rooms, where they are filled with the requisite amount of powder; then other men and boys are employed in shaking down the powder, not ramming it, and doubling over the surplus end of the case, the end bit off by the soldier. Ten of the cartridges are then packed in one of the envelopes made by the children. In another part of the building a number of men are employed in casting bullets; these are cast in rows of five, two rows being cast in one mould; each casting produces ten bullets; these are next carried to tables, at which men are employed in cutting the bullets from the surplus metal. These boys are paid 1s. a day and overtime, and many of them earn as much as 10s. a week. The cartridges, after being packed in tens in the envelopes, are next packed in deal boxes, each containing 100 packages, or 1000 cartridges. The boxes are then packed in oilcloth, with an

outer covering of white canvas, and are then sent over to Tilbury Fort." We understand that about 100 boxes are packed daily: even at this rate it would occupy more than one whole year before the contract will be completed.

IMPROVED REVOLVING FIRE-ARMS.

MESSRS. BENTLEY AND SONS, of Liverpool, have patented a Rifle fitted with Revolving Chambers, similar in principle to the rifles and pistols of Messrs. Colt and Messrs. Deane and Adams, but more simple and efficient in the mechanism by which they are discharged. The "cock-comb," or finger-hold of the cock, is placed underneath the gun, and within the guard. To cock, or half cock the gun, the left hand is placed in front of the guard, and the thumb of the left hand pressed forward on the cock-comb, which resembles in shape the ordinary trigger, but is placed the reverse way. The rifle, in consequence of the great facility with which the trigger may be brought into action, will discharge five distinct charges in four seconds, the barrels being as large in calibre as the present military Minié rifle. In loading, a great improvement has also been made, the ramrod being a short rod fitted at the end, on the principle of the Archimedean screw, and requiring but one turn to force the bullet home to the chamber. This invention combines both simplicity and economy, with increased facilities for rapid discharge and more efficiency of action.

RIFLE FIRE-BOLT.

CAPTAIN NORTON writes to the *Liverpool Review*:—"I have shot this Bolt, measuring ten inches in length, and weighing one ounce and a half, with a charge of one dram and a half of Hall's powder, from Mr. Sharp's American breech-loading rifle, to the distance of more than 800 yards in a correct line, with an elevation of about 30 degrees; the shaft of the bolt was made of Memel pine, and its base was fortified with a circular piece of thick card glued on. An arrowy shower of these bolts would tell well when discharged from the walls of a fort into the trenches of the enemy. The head of the bolt can easily be converted into a percussion-shell, and used against field magazines and ammunition wagons. The action of this missile bears no analogy to Carnot's experiments with grape-shot fired *vertically*, but is the same as the ancient cross-bow bolt, thrown to a distance about three times as far as the steel cross-bow could throw it. I predict from the experience I have had with this missile, that it will become an engine of modern warfare. Fig. 15, in my Pamphlet on Projectiles is an illustration of this bolt, when used to load at the mouth of a rifle, or as it appears after having passed through the barrel when loaded at the breech."

PERRY'S BREECH-LOADING RIFLE.

THE peculiarity of this Breech-loading Fire-arm consists in the combination of a vibratory charge holder working on an arbor in a socket, and moving in a circle; a magazine or tube in the breech for

fifty percussion-caps, a piercing cone in connexion with the exploding nipple, which introduces the fire to the centre of the cartridge, producing instant explosion; also a tube forming an adjustable gas joint with the barrel, and so arranged as to be self-cleaning in the joint, which prevents any obstruction by rapid firing; all combined so as to introduce each charge separately and without breaking the cartridge, a single cap being at the same time placed upon the nipple. The charge-chamber is a little larger than the bore of the barrel, so as to prevent windage, and give the same advantage as the Minié ball does to muzzle-loaders. It can also be charged with powder and patch, and no cartridge used if desired, as the breech-chamber is loaded like a common shot-gun. This rifle is said to possess one-third greater penetrating power with one-sixth less powder than any muzzle-loading one. A ball fired from this rifle has penetrated through a target composed of 18 pine boards, each one inch thick, and an inch apart, at a distance of 80 yards. It was originally patented in 1849, but a second one is now to be taken out for improvements.—*Scientific American.*

MARINE MORTAR.

MR. NASMYTH has explained to the British Association his plan for destroying ships by means of a Marine Mortar fixed at the bow of a strongly built vessel to be propelled by steam-power. He proposes to place in the bow of the vessel, and projecting about two feet beyond it, a case large enough to contain about six hundredweight of gunpowder. A percussion ball is to be inserted at the back of the reservoir of gunpowder, to explode at the instant that it strikes against the ship to be destroyed. The mortar vessel is to be built of blocks of timber, so strongly as to be able itself to resist the effects of the explosion, which would completely destroy the enemy's ship. Such a marine mortar, it was stated, could be amply manned by "three brave fellows," who would be secured from danger by the strength of the ship and its recoil, and by then occupying positions least exposed to injury, even should the explosion do damage to the parts nearest to it.

NEW AUSTRIAN GUN.

THIS new Gun, of which Austrian military men speak highly, only differs from the common musket in the fact that six very superficial grooves are cut down the inner surface of the barrel. The surface of the lower half of the bullet, which must be of very soft lead, is deeply notched, and the action of the ramrod naturally forces the projecting edges of the bullet into the grooves. The barrels are furnished at the breech with what is technically called a "thorn." This thorn, or *tige*, is a round solid piece of iron projecting nearly an inch and a half into the inner and lower part of the barrel. Round the thorn—that is, between the thorn and the inner surface of the barrel—there is naturally an empty space, and into this the charge of powder falls. When the indented or crimped bullet is rammed down, it *completely fills* the lower part of the grooves, but can

descend no further than the point or top of the thorn; "and the consequence is, that the powder being subjected to no pressure, every grain of it ignites at one and the same time, and propels the ball with prodigious force."

EXPLOSIVE SHOT FOR CANNON.

MR. WILLIAM TIBBALS, of South Coventry, Connecticut, has patented this Explosive Shot for Cannon, which possesses peculiarities different from the other explosive shot heretofore tried. It is conical, hollow, and contains powder; has a nipple on its point, and is covered with a jacket of soft metal which has flanges, and which allows of the shot being rammed down so tight as to prevent windage, but not affect the explosion of the percussion cap on the nipple of the ball. The shot is discharged by a charge of powder behind it, and when its point strikes an object, the soft metal case is driven down forcibly on the cap, which explodes, ignites the powder in the hollow shot, and then it explodes, scattering destruction all around.—*Scientific American.*

NEW CANNON SHOT.

MR. TULK, of the Lowca Iron Works (Tulk and Ley), has invented a mode of applying the principle of the Minié rifle bullet to shot, for either plain or grooved cannon. Non-military readers may not, perhaps, be aware that 1-16th of an inch "windage" is allowed in our artillery service and that of the French—that is to say, the diameter of the shot is 1-16th less than the diameter of the bore, in order to let the former pass down the gun. But this occasions much waste of the effective force of the gas generated by explosion of the powder, by permitting it to escape through the interstice. Mr. Tulk's object is to close the interstice, on the exit of the ball, so as to determine the whole of the disruptive gas to its propulsion. This he proposes to accomplish by making the shot to consist of three simple parts. The main body of the shot is a cast-iron cylindrical cone, like the Minié shot, and may be either solid or hollow. A second part, of cast-iron, consists of a solid or hollow cylinder combined with an inclined cone. These two parts fit into each other, passing through the third part, which is a single or double lead ring, fitting closely to both. When the shot, thus made up, is put into the cannon, the conical end points towards the muzzle. The conical plug lies next to the powder, and the leaden ring between the two. When the powder explodes, it drives the plug with great violence into the ring, and causes the softer metal of which it is made to expand, until its exterior surface presses perfectly gas-tight against the interior of the cannon bore. Thus, the whole force of the explosion is expended on the propulsion of the shot.—*Whitehaven Herald.*

IMPROVED FIRE-ARMS.

AMONG the many improved plans of Fire-Arms which have been brought before the public within the past year, we have to record another by Daniel B. Neil, of Mount Gilead, Ohio. It has for its

object the firing of two charges, one after the other, from the barrel in which they are placed, by means of a common gun-lock. Two priming holes are bored in the side of the barrel, and two charges are inserted at once. The lock is so arranged, with a hammer having two heads, as to strike the cap of the first nipple on the side of the barrel, and discharge the first ball; and then to strike the nipple of the second priming orifice, and discharge the second ball. This one-barrelled gun is intended to possess all the advantages of a double-barrelled one. It can be charged with ball or shot. For fowling-pieces, it will be of great value.—*Scientific American.*

NEW BULLET.

MR. WM. PALMER, of Feltwell, has invented a ball suitable both for small guns and cannon, which he describes as far more deadly and destructive in its effects than any yet in use. He says, "It cuts, wounds, and lacerates in such a manner that it is scarcely possible that any animal or man should live after being struck by it. A ball that would fit a common gun—say 5-8ths of an inch in diameter—expands on leaving the gun to 4 inches, and the instant it touches anything, cuts in all directions. A cannon-ball on the same principle would cut a space of at least 2 feet. The invention has been tried several times in small guns, and it does not appear to affect the flight of the ball in the slightest degree. It would be a very destructive shot in a regiment."—*Norfolk News.*

IRON MUSKET-BALL.

EXPERIMENTS have been made at Berlin with a newly invented egg-shaped iron Musket Ball, which has the triple advantage of weighing about a quarter of an ounce less than the present leaden balls, and of penetrating a cuirass at 400 yards (whereas, even the fulminating needle balls flatten ineffectively at 200 yards), and of being much cheaper than lead.

PATENT WHEEL FOR GUN-CARRIAGES.

MESSRS. BOYDELL AND GLASIER, of the Camden works, have patented a new description of Wheel for Gun-carriages, and other vehicles, the uses of which require that they should frequently pass over rough and uneven roads, and sometimes over places where there is no road at all. The invention consists of a series of shoes or short trams, which are attached to the ordinary carriage-wheel, and make for it as it rotates an endless railway, each piece being sufficiently long to bridge over any temporary obstacle. It is expected to be very useful in the transit of artillery over ploughed ground, large stones, &c. Government has given its sanction to the invention by ordering a gun-carriage for the Crimea, and several artillery officers have expressed their approbation. There is no doubt but that the plan will be useful in making temporary levels for the wheels in uneven places, but then the difficulties of traction under ordinary circumstances will be much increased, and should the carriage at any time come to a rut of greater length than the shoe, there may be some trouble in getting it out again. However, the first difficulty is, we believe, got

over by making the shoes to screw on and off; and seeing that they are each of considerable length, the frequent occurrence of the second is not very probable.

THE WIND OF A CANNON-BALL.

THE *Salut Public*, of Lyons, relates the following fact, which it points out to the attention of physiologists:—"An officer of the French army, whom General de Martimprey had sent to make a reconnoissance in the neighbourhood of Sebastopol, was knocked down, not by a cannon-ball itself, but by the wind of it as it passed close to him. The commotion produced was so intense that the tongue of the officer instantly contracted, so that he could not either put it out of his mouth or articulate a word. Having obtained leave of absence, he returned to Marseilles, where he underwent treatment by means of electricity. After the first few shocks the tongue began to move with more facility, but without his being able to speak. On the twelfth day he was subjected to an unusually violent shock, which produced the desired effect, and in a few minutes after the patient recovered his speech. He is now fully recovered, and expects to return to his post in a few days."

COMPOSITION OF GUNPOWDER.

THE following are the results of some apparently very carefully conducted analyses of different samples of Gunpowder, made by C. Waltzien:—

	Artillery Powder.				Sporting Powder.	
	Baden.	Prussian.	Bavarian.	French.	German.	English.
Saltpetre . . .	72·94	73·58	72·50	73·74	76·95	79·36
Sulphur . . .	12·01	12·45	12·62	13·60	11·52	10·63
Water . . .	2·25	1·89	1·62	2·88	3·60	0·90
Charcoal: Carbon .	10·65	10·12	11·73	10·29	9·58	8·76
Charcoal: Hydrogen .	0·49	0·83	0·73	0·58	0·48	0·60
Charcoal: Nitrogen and Ash .	1·66	1·33	1·35	..	..	..
Charcoal (total)	12·80	12·28	13·81	10·87	10·06	9·36
	100·00	100·00	100·00	101·09	102·13	100·25

The chief feature in these analyses is, that the charcoal has been determined directly as well as the saltpetre and sulphur, and not, as in all previous analyses, calculated as loss. The excess apparent in some of the analyses arises from the estimation of the water being too high.—*Liebig's Annalen*, May, 1854.

THERMOGRAPHY, A NEW KIND OF PRINTING.

M. FELIX ABATE, of Naples, has found that wood when impregnated with acid and pressed in contact with a piece of paper, will impress a copy of its surface upon the paper, which will be rendered visible and fixed by the action of heat. His process is as follows:— *Suppose a sheet of* veneering wood be the object from which impres-

sions are to be taken, it is to be exposed for a few minutes to the cold evaporation of hydrochloric or sulphuric acid, or it may be slightly wetted with either of these acids diluted, and the acid then well wiped from the surface. Afterwards it is laid upon a piece of calico, or paper, or common wood, and by a stroke of the press an impression is taken, which is of course quite invisible; but by exposing this impression immediately after to the action of a strong heat, a most perfect and beautiful representation of the printing wood instantaneously appears. In the same way, with the same plate of wood, without any other acid preparation, a number of impressions about twenty or more are taken; then as the acid begins to be exhausted, and the impressions faint, the acidification of the plate must be repeated as above, and so on progressing, as the wood is not in the least injured by the working of the process for any number of impressions. All these impressions show a general wood-like tint, most natural for the light-coloured woods, such as oak, walnut, maple, &c; but for other woods that have a peculiar colour, such as mahogany, rosewood, &c., the impressions must be taken, if a true imitation be required, on a stuff dyed of the light colour of the wood. The impressions thus made show an inversion of tints in reference to the original woods, so that the lights are dark, and *vice versâ*, which however does not interfere with the effect. This arises from the fact, that all the varieties of tints which appear in the same wood are the effect of the varying closeness of its fibres in different parts, so that where the fibres are close the colour is dark, and light where they are loose; but in the above process, as the absorption of the acid is greater in proportion to the looseness of its fibres, the effect must necessarily be the reverse of the above. When, however, it is desired to produce the true effect of the printing wood, the following process is adopted: The surface upon which the impression is to be taken is wetted with dilute acid, and is then printed upon with the veneering wood previously wetted with diluted liquid ammonia; it is evident that in this case the alkali neutralizing the acid, the effect resulting from the subsequent action of heat will be a true representation of the printing surface.

Thermography may perhaps prove useful to the decorative arts, particularly in the production of imitations of rare and costly woods, mosaics, inlaid work, &c. for paper hangings, or for furniture in place of veneering.—*Journal of the Society of Arts.*

BANK-NOTE SURFACE PRINTING.

A PAPER has been read to the Society of Arts, "On the Bank of England Note, and the Substitution of Surface Printing from Electrotype, for the ordinary Plate Printing," by Mr. A. Smee, F.R.S. In the new Note, improvements have been made in the paper on which the note is printed; and by the employment of Mr. John Smith's patent the water-mark has been carried to greater perfection than heretofore. For the first time, the letters and figures of the denomination are shaded, which produces artistic effect, and increases the difficulty of forgery. Many details were afforded of the extreme

care taken to protect the public by preventing a single sheet of paper from being possibly abstracted from the formation of the pulp at the Bank paper-mills, by Mr. Portal, to the final destruction of the notes. A new Britannia has been devised by Mr. Maclise, R.A., and engraved by Robinson, to be used in the place of the former vignette; and the writing on the new note is rendered, "I promise to pay to bearer on demand," instead of "I promise to pay to Matthew Marshall or bearer," as heretofore. Mr. Smee stated that he had proposed to the Bank a system whereby surface-printing from electrotype should be substituted for the plate-printing, and that with Mr. Hensman and Mr. Cole they had succeeded in bringing typography into successful operation. For this purpose the Britannia had been cut in steel by Mr. Thompson, and the letters had been produced in the best possible state of excellence by Mr. Skirving. The originals are never employed for printing, but are simply used as mould makers, from which electro-casts are taken, by the use of the Smee's ordinary battery and precipitating trough. The electro-metallurgic processes, as used in the Bank, were described, together with several new points in connexion therewith. The bank-notes by this system are printed at a steam-press, constructed by Napier, and no less than 3000 are printed per hour. The author called attention to the theory of inimitability. He stated that the system pursued by the Bank was so perfect that no forged note had ever escaped eventual detection. By the new system, perfect identity would be insured, and thus traders had only to pay attention to the quality of the paper and the character of the design, to protect themselves. The author stated that importance was attached to identity; but further he considered, that the doctrine of inimitability should be classed with the fanciful dreams of the Philosopher's Stone and elixir of life of a bygone age. The paper was illustrated throughout by the means by which Mr. Smee's system has been carried out, as well as by specimens of the different parts of the processes required, and specimens of various denominations of bank-notes were exhibited. Next were read "Observations on the means available for securing Bank Notes, Cheques, and similar important documents, against Counterfeit and Alteration," by Mr. W. Stones. In a communication to the Secretary from Councillor Auer, Director of the Imperial Printing Office at Vienna, it is stated that they endeavour to prevent the possibility of the forgery of bank notes, by adopting a combination of processes, including the Nature-Printing process, each opposed to the other in its manner of printing.

ZINCOGRAPHY.

M. DUMONT, of Rue Dauphine, Paris, has described, under the name of Zincography, a process of electrical engraving of some promise. He designs some particular subject with a sort of lithographic crayon upon a thick plate of zinc, planed and rubbed with fine sand, by means of a steel tool. He then spreads over the design a fine powder, composed of resin, Burgundy pitch, and

bitumen of Judea; on heating the zinc plate the powder melts, and is transformed into a varnish, which spreads itself over the parts of the surface which has been covered with the fatty crayon, that is, upon what constitutes the design. In order to etch the plate and obtain the design in relief, he places it in a bath of sulphate of zinc in communication with the positive pole of a battery, having another plate in communication with the negative pole opposite to it. The current passes, and corrodes or etches the zinc which is not covered with ink, by which the design is brought out in relief. A cast is then taken in gutta percha, upon which is deposited a copper-plate with which proofs can be printed by the ordinary printing-press. M. Dumont's process is a new application of a principle already utilized by M. Beuviere, and which M. Baldun has successfully put in practice in his attempts at photographic engraving.—*Moigno's Cosmos.*

GOVER'S PATENT POLYTINT PRINTING-MACHINE.

THIS Machine is designed to print a number of colours at the same time, and differs essentially from any hitherto constructed, both in principle and action. It consists of a series of plattens, or pressing surfaces, according to the number of colours in which it is desired to print, arranged equidistantly round a common centre, by means of which colours are printed simultaneously on a suitable number of sheets of paper, the sheets being moved successively from one block to another. Beneath the plattens are placed the blocks or surfaces to be printed from, each block being supplied with a different coloured ink by a suitable apparatus. There is also a rotating table, on which are fixed the tympans for carrying the paper, there being as many tympans as there are blocks. In order that each sheet of paper may, in succession, receive an impression from all the blocks, the rotating table, after each action of the plattens, carries the paper from each block to the next; and, at each such action, a perfect impression is withdrawn, which has successively received the various colours. The first block is then supplied with a fresh sheet of paper; and the previously supplied sheets of paper, still in the machine, are advanced one stage.—(For details, with illustration, see *Mechanics' Magazine*, No. 1594.)

THE NATURAL SELF-ACTING PRINTING PROCESS.

THIS beautiful invention, recently made in Vienna by M. Auer, director of the Imperial Austrian Government Printing-office, is, we believe, little known in England. An account of it in English, with twelve beautiful quarto specimens of the results obtained by it, has been published, and describes the process. By means of this art plates are produced "for printing copies of plants, materials, lace, embroideries," &c. These plates contain the most delicate hollows and elevations, which the human eye is unable to detect, and they are capable of producing two results on paper; the one a copy of the *original, on a white ground,* in various colours, with one single

impression, and the other a copy in white, on a coloured ground. The first of these is obtained by the copper-plate press, and the second by the ordinary printing-press; the effect being obtained in both instances without the aid of drawing or engraving.

In taking the impression of a dried plant, or a leaf, or an insect, the object is placed on a polished surface of pure lead, and above the object is placed a polished plate of copper or steel. The two plates are then passed through the two cylinders of a copper-plate printer's press, which gives a momentary pressure of from 800 to 1000 hundred weight. After separating the plates, it will be found that the tissue of the plant has been pressed into the lead plate, and when the substance is carefully removed from the plate, the design appears hollow upon its surface. From this mould, plates fit for printing may be obtained, either by the electrotype or the usual stereotype process.

When lace or any fabric is to be copied, it is smeared over with spirits of wine, or Venetian turpentine, before being laid upon the lead plate.

The price of impressions thus obtained is so moderate that a leaf in folio will cost only from eight to twelve kreutzers, that is, from threepence to fivepence.

The Chevalier von Heufler has published, by means of this process, a collection of the cryptogamic plants from the vale of Arpaset, in Transylvania.

M. Auer took out a patent for this process on the 12th of October, 1852; but in imitation of France, who gave up the Daguerréotype for general use in 1839, and of Russia, who gave up the Electrotype of Jacobi, in 1837, the Emperor of Austria has given up this new process to the public.

Messrs. Bradbury and Evans have produced a collection of interesting specimens of a patent process, entitled, "A Few Leaves from the newly-invented process of Nature-Printing," consisting, as the title implies, of botanical subjects—chiefly ferns, and other wild flowers—upwards of thirty in number, and involving every variety of colour and treatment. They are, in all respects, admirably executed, and cannot but prove of great value to the student of botany, to whom the formation of collections of original specimens, though a labour of love, is one sometimes of considerable difficulty. The *modus operandi* of the new process may be briefly described:—The natural object having been laid out and pressed on paper, a cast is taken of it by the agency of electricity, and this forms the printing surface, from which any number of impressions may afterwards be worked. Though most readily applicable to vegetable substances, which are at once capable of being arranged so as to present a surface in low relief, it is equally available, with a little arrangement, to the reproduction of fossils, and other natural objects. Considerable pressure is used in printing, whereby the branches, leaves, &c., are made to stand out in the same relief as the originals, when glued to paper.—*Illustrated London News*, No. 712.

FABRICATION OF PAPER.

The great and increasing scarcity of the raw materials used in Paper-making has led to the suggestion of a variety of new materials and processes, to meet the extended demand. A correspondence upon the subject, between the departments of the Treasury and Board of Trade, has led to no important result. From the new materials and processes proposed, we select the following.

British Plants.—Whether we can grow paper materials so cheaply as they may be imported is a question to be answered by no other means than by experiment. The problem to solve is, whether it is more profitable to grow an acre of corn, of root-crop, or of paper materials? Paper materials are vegetable fibre. All plants consist largely of this substance, but in some it is more abundant than in others, or more separable, or finer, or of a better colour. Those plants will be best suited for the purpose in question in which it is most abundant, most separable, finest, and whitest. We are surrounded by suitable plants, but they are not cultivated. Nettles and mallows, in particular, are well known to possess the necessary qualities; so does the Spanish broom and probably the common broom; any of these thrive in poor soil, where better crops cannot be produced. The common stinging-nettle is an example of what we mean. Its fibre is very fine and good, scarcely inferior to hemp, and has been used in Germany in the manufacture of first-class paper. Fishing-lines and cordage of good quality are also said to have been prepared from it. Wherever anything can grow there the nettle is at home; no bad seasons hurt it; no neglect injures it; and it is subject to neither blight nor mildew, nor the ravages of insects. Mallows are to be had everywhere; and from them a white fibre is procurable in abundance. We do not find that it has been employed in paper-making, but its fibre is known to have been used for cordage. The Spanish broom (*Spartium junceum*) is reported to yield a very good substance without much trouble.—*Gardeners' Chronicle.*

Vegetable Leaves.—M. Vivien, of Paris, patented in this country a method of manufacturing Paper from the leaves of trees, plants, &c., of all descriptions. The leaves which are gathered at a suitable season, are compressed into cakes, and then steeped in lime-water, or in an alkaline solution, after which the mass is washed and reduced to pulp by any suitable means. This pulp is then treated according to the quality of the paper to be produced, by applying to it the different operations of sizing, bleaching, &c., in the ordinary way. If it is thought necessary, the pulp formed in the foregoing manner, from vegetable leaves, may be mixed with rag or other pulp in any proportions.

Wood.—At a late meeting of the French Society for the Encouragement of National Industry, a communication was read explaining how Wood may be converted into Paper. The bark is taken off, and the wood *is reduced into* shavings; the shavings are then cut *very thin; they are next placed* in water for six or eight days, dried, *and afterwards reduced to* the finest powder possible by a corn mill.

This powder is mixed with rags, which serve to prepare the pulp of paper, and the ordinary operation of paper-making is proceeded with. All white woods, such as the poplar, the lime, and the willow, are suitable for the purpose, but the discoverer ascribes a good deal of his success to the quality of the water he employed—that of the little river Doller, which runs near Mulhausen. For the first experiment he employed the wood of the aspen. No doubt can exist that wood may be made into paper, provided it can be reduced into threads or particles fine enough for the purpose. For what is flax or hemp except wood, whose fibres are readily separable? There is no difference between the wood of hemp and of willow, or other soft trees, than such as arises from the greater cohesiveness of the threads of the latter, or from greater toughness, which is not a difference of importance in paper-making, for the weakest wood is stronger than cotton dross, now so largely used in all paper-mills. The only question is, can the cohesiveness of the fibres be overcome, or does the substance produced by grinding into pulp, either when used alone or mixed with other pulp, present a material fit for paper? We apprehend that it does. The Mulhausen experiment is reported to have been made with timber. Suppose that the newly-cut branches of poplars, limes, and willows had been macerated for a fortnight, cut into suitable lengths, and then put into a tearing (not grinding) mill, where they could be worked with water, we suspect that good pulp (or at least "half-stuff") would have been obtained without a preliminary reduction of the wood into shavings, and an after-process of grinding.—(*Gardeners' Chronicle.*) —M. Charles Cheron, of Heimsprung, near Mulhausen, states that he has succeeded in overcoming every difficulty in preparing wood so as to serve as a material in the manufacture of paper.—*Bulletin de la Société d'Encouragement.*

A patent for the manufacture of Paper from wood fibre has been taken out by Messrs. Watt and Burgess. It is said to be equal to any writing-paper now selling at 7d. a pound. The cost of production is stated to be somewhat under 25*l.* a ton—more than 12*l.* less than the price of rag paper now in use. What with straw paper, and wood paper, there seems to be an end to the fear of rags not being capable of coping with the growing literary wants of the age. Doubtless it was this very fear, together with the cost of rag paper, which led inventive minds to the idea of using other fibrous substances, such as straw and wood, as substitutes for linen and cotton fibre in the composition of paper.

American Material.—The *Long Island Vindicator* says:—"Dr. Antisel has invented a pulp, which, in its raw state, will not cost more than about one-sixth of a cent per pound, and, by the aid of a machine invented by Mr. Nolan, can be brought into the market, made into paper, at a cost of about four cents per pound. Paper at present costs about sixteen cents, so that the value of the invention can at once be seen. The material from which the pulp is manufactured *will flourish* and grow abundantly in ground that is at present useless *to the farmer,* and here, too, the community will be the gainers.

We have seen and examined specimens of the pulp, and have no hesitation in pronouncing it just the thing wanted. It is as white and clear as the most clearly bleached cotton, and it is capable of the most delicate tint. The harshness and transparency of the straw paper is not to be found in it, while it is capable of the highest finish, maintaining all the pliancy and toughness of the pure linen rags."

Refuse of Sugar-Cane.—Dr. Cumin has submitted to the Duke of Newcastle (then Foreign Colonial Secretary) specimens of paper made from the refuse of the sugar-cane, of the raw material, and of the article in the first and second stages of its manufacture. The opinions expressed by paper manufacturers of this dried pulp and paper are very favourable; and as the cane refuse is used for fuel in our sugar colonies, and great quantities of it from the sugar plantations on the Mississippi are annually thrown into the river, there is reason to believe that the article could be imported into this country at a very low rate. The experienced Mr. Thomas De la Rue is of opinion that the woody fibre of the waste sugar-cane is peculiarly well adapted for the production of high class paper; but as the decomposition or removal of its cellular structure will entail considerable loss in weight, it becomes problematical whether it admits of being *profitably* used in paper making.

Turf.—Mr. W. H. Clarke has patented a process, the specification of which states that Peat which has not undergone too great a decomposition or decay, and in which the fibrous and ligneous parts have consequently preserved a certain tenacity of texture, is to be washed with water, so as to remove sand and earth, the turf, if dry, having been first pulverised. This washing, or rather elutriation, is not considered to be necessary when papier maché or carton-pierre are to be made. The clean vegetable matter, before being reduced to pulp, is first soaked during a couple of days in a solution of about six parts, by weight, of potash, (soda would answer equally well,) and six of fresh slaked lime in one hundred of water. When fully digested, the vegetable fibre is separated from the alkaline ley by washing, and is then submitted to the action of water moderately acidulated with muriatic acid during 24 hours, after which it is bleached and reduced to the condition of pulp by the ordinary means. This process is identical with that of M. Lallemand. It is probable that the centrifugal machine, on the principle of that employed in sugar factories, might be advantageously employed in the purification of turf fibre, especially in the removal of the ley of soda, and that a far more perfect and rapid bleaching might be effected by means of a mixture of Epsom salt and bleaching powder which would produce sulphate of lime and chloride of magnesia. This was one of the first bleaching compounds proposed, and was again employed by Claussen for bleaching flax cotton. Its use can only be determined by its cost; if Epsom salt can be had cheaply, and that the waste magnesia could be so economized, there can be no doubt that the bleaching of such dark coloured *fibres* would be much more easily effected than with ordinary *bleaching powder.* It appears that Lieut.-Col. Dickson, of Croom Castle, in the county of Limerick, has taken up this patent, and in

conjunction with Mr. Clarke, has erected experimental works at Clonlahard and Tarbert, in the County of Kerry, where it is proposed to prepare materials for making paper, papier maché, carton-pierre, &c.

Materials from India.—Mr. T. C. Archer, in a paper read to the British Association, said, Dr. Royle had brought under notice the fibrous materials of India, and he seemed sanguine they would prove useful in making so necessary a material as paper. From his own examination, however, he thought those materials were too harsh and required too much labour to reduce them to a pulp sufficiently fine for making the ordinary letter-paper. Most vegetable fibres could be made into paper, and therefore there was no fear as to the supply of the coarser kinds of paper. The present difficulty was to supply paper for printing and writing upon. This paper required to be extremely white, and smooth in texture. All materials from the East Indies, except cotton wool, were destitute of that roughness of surface required to form a tenacious pulp, and when broken up they resembled straw, rather than the fine woolly fibre of linen rags broken to pieces. There was China grass, plantain fibre, jute fibre, the fibre of the paper mulberry, and the aloe fibre. These and other fibres he had examined, and they appeared perfectly smooth, hair-like tubes. Cotton, and old linen after use, and only after use, had both rough surfaces on their individual cells. He thought it an important point that paper materials should have an adherent surface, rather than a strong fibre, which had the means of attaching itself to its neighbouring fibres, and allowed the pulp to be thoroughly amalgamated. Instead of going to the East Indies, he suggested they should go to South America. He believed that the materials of a proper kind for paper could be procured there abundantly. He had been led to this conclusion by receiving a single sample of bark which he was told could be bought in unlimited quantities. In those countries, the more they cut trees, the more luxuriantly they grew up. He was totally unable to tell them the name of the tree, as that was the only specimen he had seen. They would see by the specimen itself that this was a suitable material, possessing all the woolliness of cotton fibre, as he had proved by submitting it to a microscopic examination. Each individual cell was rough on the surface, and this he thought was the desideratum required. The plant had three or four layers of this fibre. He thought it belonged to the class Thymelaceæ, and was nearly allied to the Lace-bark tree. He considered that from the palms of South America, from the grasses of the savannahs, and other natural products of that continent, more suitable materials could be found than could be derived from India. The bark of our own osiers when stripped off by the basket-makers, would also yield a useful material. In answer to a question, it was stated the material came from the Brazils. Dr. Lankester said it was true these fibrous materials could be found and converted into paper; but the point to be decided was, whether the material could be got in such quantities, and at such a price,

as to make as cheap a paper, or a cheaper paper than was now manufactured. They could make paper from nettles and sedges cheaply so long as these grow wild, but if they had to be cultivated the expense would be much increased. Mr. Archer replied, a vessel could be freighted to Liverpool with this material for paper at 10*l.* per ton, a price below the material from which paper is now made. Mr. Archer further stated the material could be procured near the sea-side in large quantities. He suggested that it could be cut up for pulp after the manner of a chaff-cutter.

Dr. Lyon Playfair, in his reply to the Minute Paper of the Board of Trade, says:—"Many attempts have been made to furnish new raw materials for paper, but hitherto with only partial success. The failure generally results from one or more of three causes. Some fibres require so much cost to bring them to the state in which they are offered to paper-makers, in the form of rags or cotton waste, that in point of economy they cannot enter into competition with the latter. Certain fibres lose so much weight in bringing them to this state, that they cease to be economical. Certain fibres, which are well adapted on account of their texture for the paper-trade, present so many difficulties in bleaching them, as to render them unfit for white paper. The Surat bass, in which cotton has of late years been imported into this country, offers an example of this difficulty."

A NEW GERMAN PAPER-FACTORY.

A VAST Paper Manufactory has been erected in Freiburg, for Mr. Flinsch, of Frankfort-on-the-Maine. The ground-floor of the west wing contains a store-room for unsorted rags, and holds 6000 cwt. The roof is supported by three pillars. Parallel with this lies the sorting-room, where between forty and fifty persons are daily employed. After this come the washing and boiling rooms, the colouring-room, &c. On the upper story is the room for the sorted rags, consisting of three divisions, and, reaching to the roof, it extends over the whole wing, and holds 6000 cwt. The centre building contains the machinery. In the two first stories are the cylindrical machine, the turbines, the half-manufactured material, the vats, the reservoir, &c. The room for the cylindrical machine is 42 feet wide, and reaches up to the third story. Sixteen cast-iron pillars support the eight machines which tear the rags. These pillars sustain all the motive powers of the machinery, and are made hollow, to let off the water used in the machine. At the foot of each pillar is a receptacle for anything which may have remained in the water. North of the machine-room is the glass enclosure for the turbines—a terrace-like erection of 42 feet in length and 15 feet in depth; the roof forming a gallery, from which is a fine prospect of the surrounding mountains. The three turbines (after Jonval's invention), of 60-horse power, work the machine, pumps, &c. The room for the half-converted material runs parallel with, and is of the same size as, the machine-room. The material is kept below in firmly-pressed masses, each of which contains from 600 to 700 cubic feet, ready to be transported above, and

from thence to the machine, which completes the process. It is raised by machinery on the west side of the room. The pump, reservoir, and other water-works, are all on the third story, the centre of which is arranged as lodgings for married and single workmen, each consisting of a bed-room, kitchen, &c. East is the machine-room, which occupies more than half the wing. The machine itself is from the manufactory of Messrs. Wyss and Co., of Zurich. The improved smoothing or facing apparatus is constructed after the design of Mr. Flinsch, and is the largest in Germany. There is an hospital, too, for sick workmen, and the establishment is warmed by hot-water pipes. The design for the building, together with the machinery, was made by the firm of Mr. Schroeder, of Carlsruhe; and the execution is the work of Professor Schneider, of Freiburg.—*Builder*, No. 573.

PAPER-MAKING IN SCOTLAND.

Mr. Cowan, M.P., has given to the Royal Scottish Society of Arts, a sketch of the various changes and improvements in the Manufacture of Paper during the last thirty years. He concluded his paper by stating that in the county of Edinburgh, which is a considerable seat of the paper manufacture, there are about twenty-four machines in operation. Supposing these machines travel at the average rate of 36 feet per minute (some of them travel at 50), and supposing that they work fifteen hours a-day (some of them go day and night), this will be equal to about 147 miles of paper per day, about 5 feet broad. Mr. Cowan believes that there are about 360 machines in Great Britain, producing daily about 2160 miles of paper.

REMOVAL OF INK FROM PAPER.

A correspondent writes to the *Athenæum:*—"Having seen in your periodical that the invention of a process by which the printing ink could be effectually removed from paper would be a desideratum in the present critical state of the paper trade, it struck me that this could be effected with ease by a very simple chemical process. I, therefore, put it to the test of experiment, and found my anticipations fully realized. The enclosed specimen was an octavo leaf, *printed on both sides*, which, on being subjected to the process, was reduced to a *clean* pulp; but my not having at command any efficient apparatus for pressing and finishing the paper will account for the coarse texture of the enclosed. This is of no consequence, as any maker would be able to supply this deficiency;—my experiment, however, sufficiently proves that the ink can be removed so as to admit of the paper being reprinted." The sample sent is, as the Correspondent describes it, free from ink.

INDIAN FIBRES.

Dr. Forbes Royle has read to the Society of Arts a paper on "Indian Fibres fit for Textile Fabrics or for Rope and Paper *Making.*" According to him, we have boundless resources of

material, not only for paper-making, but for cordage, in the white-fibred plants of India; such as the bow-string hemp, the aloe, the pita-fibre, the pine-apple; and, above all, the plantain, which would rival Manilla hemp, or the American aloe, which bridged over broad rivers. The oakum of these plants might be converted into paper, and the fibres into fabrics of different qualities; and though they might not be fitted for making knots, they would answer for many kinds of ropes, which would be capable of bearing considerable strains. But it was important to find a substitute for Russian and Polish hemp, which we possessed not only in the hemp of the Himalaya, but in the various nettles which clothed the foot of these mountains, from Assam to the Sutlej. One of the latter, the Rheea fibre (in all probability the same as the Ramée,) would not only undersell every other fibre, but in point of strength would take a position second to none of all the fibres at present imported. Some of these fibres had been made into a five-inch rope, and had been tried at Messrs. Huddart's rope manufactory, when it was found that each square inch made from the wild rheea bore, in the first experiment, 844 lbs.; in the second, 894 lbs.; and that from the rheea fibre, 910 lbs.; while the average strength of rope made with the best hemp, and after numerous experiments, from the year 1803 to 1808, was 805 lbs. per square inch. In December, 1853, some experiments were made at the East India Company's military stores with fibres in equal weights and of equal lengths. The following are the results obtained:—St. Petersburgh hemp broke with a weight of 160 lbs.; Jubbulpore hemp, 190 lbs.; Wuckoonar fibre, 175 lbs.; Mudar or Yercum fibre (common over all India), 190 lbs.; China grass, 250 lbs.; *rheea fibre*, 320 lbs.; wild *rheea* from Assam, 343 lbs.; and Kote Kangra hemp, no breakage at 400 lbs. This is the fibre of the plant distinguished as the *Cannabis Sativa*, or Indian hemp, so well known for the remarkable narcotic action of its seeds and leaves, for which purpose it is extensively cultivated in every part of India. From the statement of Dr. Royle, it appears that the East India Company had ordered twenty tons of the rheea fibres, as well as of the Himalayan hemp, to be annually sent from India for the purpose of having them tried. Some of the rheea fibres lately sent by the Court of Directors to the Manchester Commercial Association have been valued by the Messrs. Marshall, of Leeds, at from 48*l*. to 50*l*. per ton.

THE PLANTAIN FIBRE.

A DISCUSSION lately took place in the Court of Policy of British Guiana, relative to the Fibre of the Plantain, when Mr. Von Netcher said—"It was not necessary for him to say much on the subject, as the Governor had taken it up in his address to the combined court; but here was an article much wasted, and which would be wasted for a century, unless the legislature brought it forward. It was well known that it had taken nearly two centuries to bring sugar-making to what it was now, and the idea of making flax from the *Plantain* Fibre was new. It was not a perishable

article. It would not sour like cane. The colony was losing from 30,000 to 40,000 tons every year. From his own estate of 500 acres, a ton and a half of that valuable material was lost every day." We are informed that measures are being taken for forming industrial schools in all the West India islands, in which these fibres may be fitted for market. There is little doubt that within a few years they will be substituted for Russian hemp and slave-grown cotton, and the short fibres used for paper. The colony of British Guiana offers 1000*l.* for the first introducer of machinery which will prepare 100 tons of clean fibre for market.—*Christian Times.*

BUCKWHEAT STRAW A SUBSTITUTE FOR QUERCITRON BARK.

ACCORDING to a communication of Dr. W. H. Von Kurrer, the Straw of Buckwheat has been employed since 1852 in many establishments in Russia for the dyeing of cotton yarns and fabrics, as a Substitute for Quercitron Bark.—*Polytechn. Journal, Bd.*

CHEAP SUBSTITUTE FOR DAMP BLUE.

MR. GRÜNE proposes to substitute sulphuric acid for the expensive tartaric acid, in the preparation of Damp Blue. For this purpose great exactness should be observed in the proportions of acid and salt, as an excess of the former would injure the cloth; the proper proportions would be, 1 lb. of prussiate of potash, and 222 grains of oil of vitriol, mixed with from ½ to 1 quart of water. The prussiate should not be powdered, but introduced in pieces about the size of a nut into the cold dilute acid, and stirred about until complete decomposition has ensued, which takes place very rapidly. A white sediment of fine crystallized sulphate of potash is deposited, and a clear greenish-yellow solution formed, which, with the addition of boiled starch or dextrine, and the necessary quantity of ferro-cyanide of tin, may be employed for printing, &c.—*Ibid.*

RED OR VIOLET COLOURING MATERIAL PRODUCED FROM SULPHATE OF INDIGO.

IF indigo lake be stirred up with water, so as to produce a dark blue liquid, and a caustic soda ley, marking 38° of the acrometer, be added, a dark, appearing almost black, precipitate will be formed, and will remain suspended in the liquid, which will have assumed a yellow colour. If this fluid be separated from the precipitate, and mixed with excess of sulphuric acid of 66° after a couple of hours, it will again become blue. If, however, it be left standing for 24 hours, and then mixed with the acid, it will assume a green colour; and after standing from 40 to 48 hours, and the addition of a strong excess of acid, an intense red will be obtained after the liquid has assumed various intermediate shades. If the fluid be allowed to stand for about eight days before the addition of the acid, the red colour produced will be brownish; the same result will take place if heat be employed in order to hasten the production of the red colour. If wool or woollen cloth be dipped in the red liquor after it has been diluted with water, and the acid partially neutralized with water, it will be dyed of a lighter or darker shade, from rose-coloured to

amaranthus, according as the bath is more or less concentrated, and the temperature higher or lower. If a bath of liquor be employed which has only stood 24 hours before the addition of the acid, violet colours will be obtained.—*C. H. Gros Renaud, Junr., in Bulletin de la Société Industrielle de Mulhouse.*

SUPPLY OF GUM.

The last American papers contain an account of an apparently important discovery in the far west. It is asserted that in the north of Texas, towards Arkansas, as well as in the state of New Mexico and the adjacent territory, Gum has been found in inexhaustible quantities, and of a character scarcely, if at all, inferior to that imported from the East. It is gathered from the mezquite tree—a kind of acacia, abundant in that section of the country, especially in elevated and dry localities—and exudes spontaneously in a semi-fluid state from the bark of the trunk and branches, soon hardening and becoming nearly colourless by exposure. July, August, and September, are the months for collecting it, and the quantity from each tree varies from an ounce to three ounces, which may be greatly increased by incisions. Even as it is, a good hand, it is said, would probably be able to collect from 10 lbs. to 20 lbs. a-day. Should it command one-half of the prices paid for gum arabic, the gathering of it will, in the opinion of the United States Superintendent of Indian Affairs, by whom it was tested, afford employment to thousands of wild Indians of the plain, so as to constitute it a most valuable article of traffic on the western frontier.—*Journal of the Society of Arts,* No. 108.

WATER-METERS.

Mr. David Chadwick (Salford), has read to the Institution of Civil Engineers, a paper which commenced by showing the long-experienced want of a good system of ascertaining the quantity of water delivered by water companies to private houses, public establishments, or manufactories, direct from the pipes, without the intervention of cisterns, and under the varying pressure of high and low service, or under the circumstances of intermittent or constant supply.

After alluding to the statement in the Reports of the Juries for the Exhibition of 1851 (Class V.), "that no instrument had hitherto been so far perfected as to satisfy the conditions of a good meter;" the paper gave a list of the patented Water Meters from 1824 to 1853, and then proceeded to explain succinctly the several systems hitherto employed, under the several classifications of,—

1st. The diaphragm principle.

2nd. The water-wheel, the turbine, the spiral fan, the drum, and their various modifications.

3rd. The piston and cylinder.

In practice, it was said, they were all found to permit small quantities of water to pass through the meter, without registration, in consequence of a certain amount of force being required, to overcome the *resistance offered by those* parts of the meter in connexion with the *counting apparatus,* before motion could be given to it.

Mr. Siemens's inventions were well spoken of for their ingenuity; but the defect above mentioned equally applied to them.

Captain Ericsson's rotary fluid meter was shown to bear a close resemblance to that of Mr. Taylor, and to be liable to the same objections.

The reciprocating fluid meter, also by Captain Ericsson, was shown to have been used, to some extent, in the United States, and to be more effective in its action.

Messrs. Donkin and Co.'s meter, on the principle of the disc engine, possesses a certain degree of merit, but it has not hitherto been rendered practically efficient.

The instrument introduced by Messrs. Hanson and Chadwick, of Salford, the description of which was the point of the paper, consisted, the writer said, of a vessel of metal, into which the fluid entered, by a pipe at the bottom, through a wire gauze, to prevent the admission of silt or other extraneous matter; it then passed into two semicircular bags of vulcanised caoutchouc, firmly fixed on a level bed: one end of each bag opening into the meter; upon these bags rested three conical metal rollers, attached to a centre shaft, which was connected with the ordinary registering wheels and dials. The water, on passing into the bags, propelled the rollers round continuously, each revolution registering exactly the contents of the bags. The rollers worked in the water, under the same pressure as in the pipes, which was in fact continued throughout, and at its exit from the meter the water did not exhibit any appreciable loss of pressure.

It was stated, that the vulcanized caoutchouc would not, in a very long period, exhibit any signs of deterioration from working under water, and that there was very little wear and tear of the bags, as the rollers passed over them, without any sensible abrasion.

Mr. J. Glynn, F.R.S, has described to the Society of Arts the leading features of the several plans which have been proposed. Mr. Chadwick's meter had recently been brought under his notice, which it was stated only varied 5 per cent. between a head of water of one foot and one of 300 feet. In this meter a wire gauze or sieve was introduced between the supply-pipe and two inlet passages situate in the bottom of a cylindrical vessel. These passes opened into two vulcanised india-rubber bags, embedded and laid flat on the bottom of the vessel, and there were openings at the other extremities of the bags, for allowing of the exit of the water into the meter. On the water entering these bags, it sets in motion three conical rollers attached to a central spindle in connexion with the ordinary counting wheels and dial, each revolution of the rollers registering exactly the contents of the bags. A second paper read was "Description of Taylor's Water Meter," by Mr. B. Fothergill.* This meter consists of a cylindrical vessel or cistern of a size proportioned to the bore of the pipe that was to receive and discharge the water. Inside there was a drum revolving on its axis in a vertical or upright position, and the stream passing through the meter was distributed upon the drum at each side of the meter. The registration was given by a train of wheels connected with the drum, and carried to the indicator. There

* *Described* also in the "Year-Book of Facts," 1854, p. 31.

were between 100 and 200 of such meters working in various parts of the country.

THE WATER SUPPLY AND DRAINAGE OF PARIS.

According to M. Belgrand's calculations, 90,000 cubic métres (308,700 cubic feet) of water would supply Paris for all domestic and industrial purposes; that is, wherever a high service is needed. The 110,000 métres remaining out of the estimated total of 200,000 he throws on to the public service — street-watering and cleansing, fountains, fire-plugs, &c. &c., for which only a ground service would be necessary. M. le Préfet proposes to bring these waters of the Somme and Soude only for the special distribution of the high service, leaving the present arrangements for all public needs. This double distribution, he thinks, would work admirably.

The Préfet submits the following, in connexion with this improved water supply. A grand line of principal sewerage, furnished with rails for the passage of carts and wagons; then a secondary line, likewise furnished with rails for the less important streets; then a smaller conduit, large enough for wheelbarrows and tubs to pass through, which should encircle each group of houses when they could not communicate direct with the principal or the secondary sewers; and finally, a short cross pipe from the party wall of each two houses to the small surrounding sewer of the group, or directly to the principal or secondary drains, according to the situation of the houses in question. This system of drainage would be certainly as complete as care and science could make it. Not a house would be unsupplied with drains; as not one, were M. le Préfet's plan carried out, would be unsupplied with water at the high service. And combined, these improvements would be followed by certain house improvements, which all who have visited Paris know are the great domestic improvements now needed.

ARTESIAN WELL AT BRAINTREE.

The *Chelmsford Chronicle* publishes the details of a trial bore completed at Braintree. The Local Board of Health, having a strong impression in favour of obtaining a supply of soft water on the Artesian principle, instead of the hard surface water from above the London clay, consulted Mr. Prestwich, the author of a recent work, "On the Water-bearing Strata around London," and, by his advice, resolved upon making the attempt. At the depth of 245 feet from the surface, an apparently inexhaustible supply of water, said by ordinary tests to possess a considerable degree of softness, was got. The bore was made in a field adjoining Pods Brook, at an elevation, according to the Ordnance survey, of 145 feet above the sea, being nearly 90 feet below the level of the highest part of the town. From a bore not exceeding two inches at the bottom, without any head or reservoir, but merely by introducing a common hand-pump, as much as twenty gallons per minute were obtained, and no *exertions could* reduce the level at which the water stood. The

peculiarity of this trial is, the remarkable development of the mottled clays and sands between the London clay and the chalk. The well-borer, Mr. John Goode, of Great Baddow, stated that, in thirty-five years' experience in various parts of Essex, he had never met with a similar thickness in these beds; and Mr. Prestwich remarked that, though by no means uncommon to the west of London, there were no previously ascertained data to lead him to expect such a thickness in these strata to the eastward.

A flow of water has been obtained in this Artesian well. Mr. Fenton, surveyor to the Board, states that the contractor commenced sinking the shaft in August, 1853, and great delay was caused by the land springs working into the stratum of sand above the London clay. The shaft is 6 feet 6 inches in diameter, for the depth of 125 feet, with tunnels at the depth of 110 feet, to form a reservoir to collect the water when the engine is not at work. A 4-feet shaft has been sunk to the further depth of 80 feet, and from thence to the main spring a 12-inch iron pipe has been inserted. The shaft and tunnels will hold 40,000 gallons. The stratum of pebbles being reached, and the men left without any water in the shaft, next morning, at six o'clock, 30,000 gallons were found to have risen and passed into the shafts or tunnels, and, to all appearance, a supply sufficient for the town will be obtained. For two days after the water entered the well, a deficiency was perceived at the other Artesian wells in the town; but nearly all these soon recovered their usual supply.

CLARIFICATION OF SEWAGE WATER AND PREPARATION OF SEWAGE MANURE.

THE proposal made by the Prince Consort to the Agricultural Society of England, that Sewage Water might be advantageously and rapidly filtered by ascension through certain media appropriate either to the formation of required composts for solid manure, or by partial defecation only; to the preparation also of purely liquid sewage, fit for watering market-gardens with, as through pipe-hose and perforated nozzles, will be remembered by many of our readers. His Royal Highness' proposed appropriation of the upward filtering tank of water companies to the preparation of sewage has proved to be a highly practicable and valuable suggestion, in many instances; and we are enabled to state the details of one case in particular, and the first, it is said, in which the new sewage tank has been brought into use.

At Aylesbury, in Buckinghamshire, the sewage from a large section of the town discharged itself into a brook on the Hartwell-road, so near to a private residence, that the tenant threatened to indict the Local Board of Health, unless measures were taken to remove the nuisance. The attention of the Board was called to the effect that peat charcoal had in removing the offensive odour from sewage; the construction of the tank and filter was completed in August, 1852; and the result is thus shown in a letter *written by the* Chairman of the Local Board of Health to the

engineer, Mr. T. A. Yarrow, of London, engaged. The Chairman observes :—

"On the 4th of August, 1852, when the peat charcoal was put into the tank, and the sewage immediately turned into it, after passing through, the liquid that ran off was without colour or flavour, perfectly inodorous and drinkable; and several who were interested in the experiment did drink it: I, myself, did; the taste was very like soft spring water. I requested a friend to analyze some of it, and he stated the result to be, that he could not detect any ammonia in it; thus the absence of ammonia would show that the fertilizing properties of the sewage had been absorbed by the charcoal. On the 23rd of September, the water which ran from the tank had the smell and colour of sewage, by which we knew the filter had done its work, in taking up as much as it would of the offensive part, which, of course, is the fertilizing part of the sewage, and the tank was accordingly emptied.

"The quantity of charcoal put in was 1 ton 9¼ cwt., and the quantity taken out was 3 tons 5¼ cwt.—thus absorbing, in five weeks, considerably more than its own weight. The consistence of the manure, when the tank was emptied, was that of very coarse sand or grit, which rendered it capable of being drilled in with seed; it was also quite inodorous.

"The benefit, in a sanitary point of view, is, that whereas the sewage was a nuisance running into a brook and polluting water which at a short distance below was taken to be used for culinary purposes, and for cattle to drink, the smell is gone from the sewage, and the water runs clear and flavourless into the brook."

The filter alluded to in the chairman's letter, was constructed on the principle of that recommended by Prince Albert, with alterations to meet the local requirements. It purified (we are told) a section of the town containing, at a very moderate calculation, 2000 inhabitants, and the sewage passing through the filter was of a peculiarly fetid description, owing to the deficient water supply. The tank was constructed of brick and timber: was set to work within fourteen days from the time it was commenced, and the entire cost was under 50*l.*—Abridged from the *Builder*, No. 588.

SEWER-FLUSHING APPARATUS.

Some important and highly successful experiments with a new and ingenious apparatus, invented by Dr. Gray, of the *Dublin Freeman's Journal*, have been made at Dublin, in presence of the High Sheriff, the presidents of the Colleges of Physicians and Surgeons there; Professor Sullivan, of the Museum of Irish Industry; Mr. W. D. Butler, architect; Mr. Neville, city engineer; Professor Aldridge, Sir H. Jervis, Sir A. Clarke, and many other intelligent and influential gentlemen belonging to Dublin; all of whom attested, by a formal resolution, passed on the spot where the experiments were made, that they had been perfectly successful, and recommended the general application of the apparatus, both *for house purposes,* and for general city drainage, as a simple,

effective, and valuable invention. The model exhibited, comprised about 60 feet of house-drain, with, at the sewer extremity, a syphon trap, of the ordinary S shape, filled with water, and at the house extremity an ordinary beer-barrel (used to show how cheaply the apparatus might be fitted up). In the bottom of this barrel was a large valve, communicating through a tube with the house end of the drain, and a simple apparatus, it is said, was contained in the barrel, or cistern, by means of which, so soon as the cistern was filled (from the ordinary water-pipes and through a small pipe with a crane), the valve was opened, and the water, amounting to some thirty or forty gallons, suddenly flushed the drain, carrying with it stones, clay, or other contents, and expelling not only these, but the foul gases that might be contained in the drain, all of which, together with the water, are ejected successively, as by a squirt or pop-gun through the S syphon-trap into the sewer, while the foul air is replaced by air from the house, and the drain is thus thoroughly ventilated as well as flushed. The crane attached to the supply-pipe is intended for use so as to fill the cistern only by driblets, and once or twice every twenty-four hours, or as often or as seldom as may be desired, the whole apparatus being thus self-acting when once regulated.—*Builder*, No. 616.

INVENTIONS BY THE LATE JOHN MARTIN.

WE record, with regret, the death of the amiable Mr. John Martin, the painter, which occurred on the 17th of February, 1854. Mr. Martin had devoted much time and money to projects for the improvement of London, the embankment of the Thames, the provision of pure water, and various inventions connected with sanitary objects. "My attention," he says, in a very interesting autobiographical sketch communicated by him to the *Illustrated London News*, for March 17, 1849, "was first occupied in endeavouring to procure an improved supply of pure water to London; diverting the sewage from the river, and rendering it available as manure; and in 1827 and 1828, I published plans for the purpose. In 1829, I published further plans for accomplishing the same objects by different means, namely, a weir across the Thames, and for draining the marshy lands, &c. In 1832, 1834, 1836, 1838, 1842, 1843, 1845, and 1847, I published and republished additional particulars—being so bent upon my object that I was determined never to abandon it; and though I have reaped no other advantage, I have at least the satisfaction of knowing that the agitation thus kept up constantly, solely by myself, has resulted in a vast alteration in the quantity and quality of the water supplied by the companies, and in the establishment of a Board of Health, which will, in all probability, eventually carry out most of the objects I have been so long urging. Amongst the other proposals which I have advanced is my railway connecting the river and docks with all the railways that diverge from London, and apparently approved by the Railway Termini Commissioners, as the line they intimate coincides with *that submitted* by me, and published in their report—the principle

of rail adopted by the Great Western line—the lighthouse for the sands appropriated by Mr. Walker in his Maplin sand lighthouse—the flat anchor and wire cable—mode of ventilating coal-mines—floating harbour and pier—iron ship, and various other inventions of comparatively minor importance, but all conducing to the great ends of improving the health of the country, increasing the produce of the land, and furnishing employment for the people in remunerative works."

PREVENTION OF SMOKE.

A PAPER has been read to the Institution of Civil Engineers, "On the Prevention of Smoke in Engine and other Furnaces," by Mr. J. Simpson, Junr. The annoyance of smoke incidental to the increase of habitations and to the extension of manufactures, in all cities and large towns, had been noticed reprehensively, even as early as the time of Charles II., in whose reign it was proposed to legislate on the subject; and in 1697, Dr. Papin devised a scheme for forcing air down a pipe immediately above the incandescent fuel, to induce more perfect combustion. The attention of parliamentary committees was devoted to the subject in the sessions of 1819 and 1820, and again in 1843, when a very complete history of the subject was given in the report, with a clear recapitulation of the scientific evidence, recommending a freer admission of air to the furnaces as the "great, if not the only principle, for preventing smoke." In 1845, two other committees reported, "that opaque smoke issuing from steam-engine chimnies might be so abated, as no longer to be a public nuisance;" and in 1853, the "Smoke Nuisance Abatement Act" was passed, and was ordered to come into force in August in 1854. This act rendered it compulsory on owners of engines and furnaces to provide means for preventing the emission of opaque smoke, and it applied, also, to steam-vessels navigating the Thames, above London Bridge.

A paper was next read "On the Management of Furnaces, and the Prevention of Smoke," by Mr. C. W. Williams. The object of this communication was to endeavour to remove the mystery which had hitherto obscured, what was asserted to be one of the simplest and best understood processes of nature, namely, the combustion of the gaseous products of coal. A short analysis of the chemical details connected with the subject was given, to show that the existence of flame did not imply the combustion of gas.

The next evening of the meeting of the Institution was entirely devoted to the discussion of the papers by Mr. J. Simpson, Jun., and Mr. C. Wye Williams, "On the Management of Engine and other Furnaces, and the Prevention of Smoke." We have only space for the general result of the investigation, which appeared to be, that, although for certain large establishments, the mechanical methods of firing were successful, it could not be expected they would be adopted for every furnace in the smallest manufactory, therefore, a good system of mingling a due proportion of atmospheric air with the gases evolved during combustion, was essential, and the method employed by Williams appeared to fulfil the required conditions.

A paper has also been read to the Institution "On the Means of avoiding Smoke from Boiler Furnaces," by Mr. W. Woodcock. It was stated that ordinary pit-coal, under the process of destructive distillation, gave off various volatile substances, some of which were gases, such as "hydrogen,"—"marsh gas,"—"olefiant gas,"—"carbonic oxide," &c.; these and others existed in the furnace only in a gaseous state, becoming liquid or solid when in the external air, and of such coal-tar was composed; and amidst them the carbon, in minute sub-division, was held in suspension, giving to the smoke its sable hue. All these gases were combustible at given temperatures, provided a certain amount of oxygen was present. It was shown, that the air containing this oxygen, if imparted to the gases, after leaving the fuel on the bars, must be administered so as not to reduce the temperature of the gases below their "flame-points." The simplest means of preventing the formation of smoke were shown to be by providing for an ample supply of oxygen in a condensed state, in the form of cold air, to the fuel on the fire-bars, and by administering such further supply of oxygen to the heated gases as might be necessary for their complete combustion whilst in contact with the boiler; this latter supply being given at such a temperature as would insure the successive ignition of the gases as they were evolved. Thus, by establishing nearly perfect primary combustion, the quantity of smoke evolved was shown to be reduced to a minimum, of which no visible trace ever reached the summit of the chimney. The apparatus by which this desirable end was attained was described, and it was stated that the results had been very satisfactory; that at Messrs. Meux's brewery, where the means had been tried, there was not the slightest appearance of opaque smoke from the chimney, and that the money saving, resulting not only from the more perfect combustion of the fuel, but from the use of an inferior quality of coal at a lower price, amounted to full twenty per cent. This success was so great as to warrant the introduction of the apparatus to the more general notice of the profession and the public through the Institution of Civil Engineers.

M. Prideaux, in a lecture delivered by him at the United Service Institution, "On the Prevention of Smoke, particularly in Steam Vessels," has described his invention for that purpose. It consists of an apparatus to be affixed to the fire-doors of furnaces, regulating the admission of air, in order to improve the combustion and to prevent the radiation of heat outwards. The front of the apparatus consists of a series of shutters, traversing in axes, so as to be capable of opening and shutting like Venetian blinds. Behind these moveable valves is a series of parallel plates fixed at a slight angle; then a second series fixed at an opposite angle; and then a third and wider series of parallel plates, which does not incline, with air spaces between each series. By means of the slight inclination in opposite directions given to the first and second series of plates, the direct radiation of heat from the fire outwards is prevented, although the air has free ingress. The stoker, after coaling, and closing the door, *raises the arm* of a lever, which throws the valve wide open. The

valve then gradually closes by the force of gravity of the lever acting on a piston in a closed cylinder of water. The time of closing is adjusted by means of a screw, and readily varied to any required limit. After coaling, the valve is half shut, admitting about 50 measures of air per minute. The whole amount of air admitted during the eight minutes would be 400 measures, and this quantity is found sufficient to prevent all smoke. The contrast is great when we consider the mode of preventing smoke by admitting air above the fuel, through an orifice of fixed size. To obviate smoke, that orifice must be large enough to admit at the rate of 100 measures of air per minute ; consequently, in each period of sixteen minutes there would pass into the furnace 1600 measures of air, or four times the necessary quantity. The 1200 superfluous measures of air contribute nothing to the generation of heat, but pass up the chimney at a temperature of about 500 degrees higher than that at which they enter the furnace, which they rob of heat to that extent, producing unmixed evils, and more than neutralizing the beneficial effects produced by the 400 measures of air really demanded for the wants of the furnace.

CONSUMPTION OF FUEL AND PREVENTION OF SMOKE.

MR. FAIRBAIRN has explained to the British Association the principles on which the perfect combustion of fuel depends, and expressed his opinion that by proper attention and by the adoption of the means already known and practised, the issuing of smoke from steam-boiler furnaces might be effectually prevented. The great secret is to have sufficient capacity in the boiler; and if the boilers had double their usual capacity the perfect combustion of the fuel and, consequently, the prevention of smoke, might be readily accomplished. He referred to the steam-engine furnaces of the Cornish mines to prove that when there is a sufficient inducement to the proprietors by the saving of expense, and of incitement to the engineers by competition, the emission of smoke is prevented without any special arrangement to produce that effect. Mr. Fairbairn then described a furnace which he conceived offered great facilities for the more perfect combustion of fuel. It consists of two furnaces united into one, the gases issuing from the coals being mixed together in a single chamber and then passed in a heated state over the bridge of the furnace, where they are ignited. By this means, and by keeping the fire-bars clean for the admission of air, the combustion was rendered very complete.

Dr. Arnott explained the principle on which the combustion of fuel is effected in his stoves. They are founded on the plan invented by Dr. Franklin, of inverting a fire-grate after the coals had been lighted, and thus having the coals at the bottom and the fire at the top. The smoke of bituminous coal may be regarded as evaporated pitch, and by submitting it to the action of heat, in ascending through the hot coals at the top, it is completely consumed and converted into carbonic acid gas and water. It is estimated that in a common fire with a large open fire-place 5-6ths of the heat passes up the chimney. By contracting the throat of the chimney the draught becomes so strong as to permit of making an opening into the chimney from the upper

part of a room without the risk of its smoking, and by this arrangement a more perfect ventilation is obtained than by any other means.

Mr. Dircks explained Mr. Williams's method of consuming smoke by the admission of jets of fresh air at the bridge of the furnace; and in the discussion that ensued, Mr. Juckes's plan of moveable bars was spoken of as the most effective for the purpose of consuming smoke, though difficult to be introduced in furnaces already erected.

DR. ARNOTT'S NEW FIRE-PLACE.

AN important paper has been read to the Society of Arts "On a New Smoke-Consuming and Economical Fireplace, with additions for obtaining the Healthful Warming and Ventilation of Houses," by Dr. Neil Arnott. The author commenced by stating that the great evils connected with the common coal fires were—1. Production of smoke; 2. Waste of fuel; and, 3. Defect of warming and ventilation. After reviewing the evils arising from smoke in the interior of houses and in the external atmosphere—which in the washing of clothes alone cost the inhabitants 1,500,000*l.* more than the same number of families residing in the country, besides being inimical to health—the question of waste of fuel was examined; and the opinion of Count Romford was quoted, who declared that five-sixths of the whole heat produced in an ordinary English fire went up the chimney with the smoke to waste. This estimate was borne out by the facts observed in countries where fuel was scarce and dear, as in some parts of Continental Europe, where it was burnt in close stoves that prevented the waste; and with these a fourth part of what would be consumed in an open fire sufficed to maintain the desired temperature. The author then proceeded to observe, that if fresh coal, instead of being placed on the top of a fire, where it must unavoidably emit visible pitchy vapour or smoke, be introduced beneath the burning red-hot coal, so that its pitch, in rising as vapour, must pass among the parts of the burning mass, it would be partly resolved into the inflammable coal-gas, and would itself burn and inflame whatever else it touched. Various attempts had been made to feed fires in this way, of which the most important was that introduced by Mr. Cutler, about thirty years ago. He placed a box filled with coal immediately under the fire, with its open mouth occupying the place of the removed bottom bars of the grate, and in the box was a moveable bottom, supporting the coal, and by pressing which the coal was lifted gradually into the grate to be consumed. The apparatus for lifting, however, was complicated and liable to get out of order, which, with other reasons, had caused this stove to be little used. In Dr. Arnott's new fire-place, the charge of coal for the whole day was placed immediately beneath the grate, and was borne upwards as wanted by a piston in the box, raised simply by the poker used as a lever, and as readily as the wick of an argand lamp was raised; and the fire was under command as to its intensity almost as completely as the flame of a lamp. To light the fire, wood was laid on the upper surface of the fresh coal filling the box, and a thickness of three or four inches *of cinder or coked* coal left from the fire of the preceding day was

placed over it. The wood being then lighted, instantly ignited the cinder above, and at the same time the pitchy vapour from the fresh coal below rose through the wood flame and cinder, and became heated sufficiently to inflame itself, and so to augment the blaze. When the cinder was once fairly ignited, all the bitumen rising through it afterwards became gas, and the fire remained quite smokeless for the remainder of the day. In this grate no air was allowed to enter at the bottom, and combustion, therefore, only went on between the bars. The unsatisfactory results of some other attempts had been owing, in part, to combustion proceeding downwards consequent on the admission of air below.

DOMESTIC FIRES WITHOUT SMOKE.

In the *Journal of Gas-lighting*, Mr. Julius Jeffreys has explained a plan for clearing the atmosphere of towns from the smoke of household fires. He proposes to make the bars of the fire-grate hollow, and to connect these hollow bars with a gas-pipe. The grate is filled with gas coke, and the grate bars are perforated with small holes on that side nearest to the coke they contain. The gas being turned on by means of a stop-cock in the usual way, and lighted by a match, quickly ignites the coke in the fire-place, which soon becomes glowing hot, and is kept so by the small jets of flame below and in front; and a bright and cheerful fire is kept up, burning with more or less intensity as the supply of gas is increased or diminished, and it burns without smoke.

Mr. Davenport, one of the officers of the Society of Arts, has adopted a method somewhat similar to that proposed by Mr. Jeffreys, for the fires of bed-rooms, which are required to be lighted on short notice, and to burn without smoking. Mr. Davenport connects a hollow ring with the gas-pipes near the chimney, by means of a flexible tube of the ordinary kind. This hollow ring is entered between the two lower bars of the front grate, is perforated on the upper side with small holes, and the fire-place is filled with coke above the ring, which lies upon the bottom grate. The jets of gas issuing from the holes in the hollow ring being lighted ignite the coke above, and soon produce a clear and smokeless fire.

NEW INODOROUS AND SMOKELESS STOVE.

The Polish general, Dembinski, has invented a cylinder of zinc, copper, sheet-iron, or any other metal, with an inner and removable heating cylinder, containing sand or small stones, and connected by means of two tubes with a very small vessel, placed on a fire or over a gas-light or lamp. The space between the two cylinders, which is small, is filled with cold water. The vessel on the fire is made of very thin metal, and is filled with water which boils almost immediately. As the water boils, it rushes by one of the pipes to the cylinder, and by the other returns to the vessel over the fire; and this process goes on till the whole of the water boils, which is in one-fourth of the time required in the usual way. The process is continued till the sand or stones in the inner cylinder have become perfectly heated.

Two stop-cocks close to the cylinder are then turned, and the pi being unscrewed, the cylinder is carried by means of handles to a room which it is intended to warm. The temperature of the room said to be increased several degrees by the use of this cylinder, whi of course, gives out neither smoke nor carbonic acid; and at the e of five hours the heat in the cylinder is still, it is alleged, so gre that the temperature of the room is very nearly what it was when cylinder was first introduced. If more than one cylinder be want the generator remains over the fire, and other cylinders can attached.—*Builder*, No. 612.

RECENT IMPROVEMENTS IN OVENS.

IN an article on this subject, in No. 11 of the *Dublin Mont Journal of Industrial Progress*, is an account of M. Rollar system of bread-baking, which was some time since made subject of a highly laudatory report by a Commission to French Academy. The oven of M. Rolland is said to combin number of advantages found isolated in the inventions of others. is circular, with floor of cast-iron plates, covered with tiles, and supported upon a vertical axis capable of moving in a collar and sock The latter is moved up and down by a vice-screw, so as to increase diminish the height of the oven space, according as the bread is large or small loaves. By means of bevelled pinions the floor revol at will. The oven is heated by a fireplace built in the masonry un the revolving floor. The smoke and heated air pass by vents and cast-iron pipes radiating upon a slightly inclined flooring of tiles, a thus heats the floor of the oven. From these horizontal flues smoke passes up through vertical flues, and thus heats the wall of oven. These vertical flues discharge into an open space between cast-iron roof of the oven and a second plate, which is covered w a thick layer of cinders or other non-conducting material, and fr this space it passes off by a chimney. M. Rolland's oven is tl heated like a muffle, but without direct contact with the fire.

PURIFICATION OF GAS.

THE attention of the City Court of Sewers was for some time oc pied with inquiries as to the supply and Purification of Gas. T subject was introduced by a Report from the Committee on Gen Purposes, to whom was referred a statement made by Dr. Lethe that he had found 21 grains of oil of vitriol in 100 cubic feet of g The Committee recommended that Dr. Letheby should be allowed proceed with certain experiments, with a view to test the quality the gas supplied to the City of London by the various gas compani and also to promote its purification. This suggestion of the Co mittee was adopted. A Report was then read from Dr. Letheby specting the power and quality of the gas supplied to the City by Great Central Company. This Report stated, that during the l three months the power of the gas had been nearly 22 per ce greater than was required by Act of Parliament, and that the res of various experiments was highly satisfactory. The Report then c

gratulated the Court upon having directed public attention to the purification of gas as one of the most important sanitary and commercial questions of the day. Nearly 4,000,000,000 cubic feet of gas are now annually consumed, of which about 500,000,000 were supplied to the city of London. The consumption of gas in London was nearly trebled since 1837, but hitherto nothing had been done to control the companies engaged in its manufacture. Coal gas was liable to be contaminated with four impurities calculated to injure the atmosphere; but, as science could furnish a remedy and render the gas pure, the report suggested that those in authority should pay attention to the subject, as the use of coal gas "might become either the greatest curse or the greatest boon of the 19th century."—*Times.*

GAS FROM A CHARRED PRODUCT.

MR. J. T. WAY, Holles-street, Cavendish-square, and Mr. J. M. Paine, Farnham, Surrey, have patented a method of distilling a compound matter consisting of a stone or earth (largely composed of soluble silica found in Surrey, and probably in other places), and tar, or fat or oil, or other organic matter; and thereby obtaining gas for the purposes of light and heat, and a Charred Product suitable for making filters and for decolorising and deoxydising purposes. Soluble silica is explained to be silica readily soluble in solution of caustic, potash or soda when boiled in open vessels, in distinction to such silica as can only be dissolved when boiled with these solutions in closed vessels, and consequently at a much higher temperature. Such silica rock is impregnated with blood, tar, or other matter, which will yield charcoal when strongly heated; and when tar is used it is distilled in an ordinary gas retort, the inflammable gases are given off, and a charcoal remains. The gas is stated, from its greater purity, to require less subsequent treatment than ordinary coal gas.

SANITARY IMPROVEMENT IN THE MANUFACTURE OF GAS.

IT is well known that the saturated lime, taken from the dry-lime purifiers, employed in the manufacture of gas, when exposed to the atmosphere, exhales a considerable portion of the sulphuretted hydrogen which it has abstracted from the impure gas passed through it. By this means there are transferred to the air large quantities of a gas which is exceedingly deleterious to animal life, and which, from the excess of its density above that of air, sinks to the lower atmospheric strata, whence it is often inhaled, to the great injury of the inhabitants of towns and cities. In order to remedy this, Mr. Mann, engineer of the City of London Gas-light Company, has invented the following arrangement. Before the vessel is opened for the removal of the screens, atmospheric air is blown through the purifier. This air, as it passes through the saturated lime, of course bears away with it those portions of the impurities which would fly off if the lime were opened to the atmosphere in the usual manner. The air thus impregnated with the sulphur compounds is conveyed to a suitable vessel containing a material which will decompose them, and retain them within it. As sulphuretted hydrogen

is the principal agent to be dealt with, oxide of iron is the material chosen; the hydrogen of the compound unites with the oxygen, forming water, aud the sulphur unites with the oxide of iron, forming sulphide of iron. The partial removal of the sulphuretted hydrogen from the spent lime, by means of currents of air passed through it, has before been practised, but with only a limited benefit, since the charged air has been sent up the shaft to be subsequently liberated; while the present invention, by decomposing the deleterious gas, altogether prevents its passage to the atmosphere, and the evil effects which result from its diffusion. The system is at present in successful practice at the Company's works.—*Mechanics' Magazine*, No. 1608.

PRODUCTION OF OXYGEN GAS.

M. BOUSSINGAULT has described a process by which pure Oxygen Gas may be obtained from the atmosphere at a trifling cost, so as to enable it to be collected in unlimited quantities, and preserved in gasometers, like coal-gas, for application to many practical uses in the arts. This process depends upon a peculiar property possessed by the earth barytes, of absorbing the atmospheric oxygen at one temperature and evolving it at another; or rather, the ready conversion of hydrate of barytes into peroxide of barium, by a current of atmospheric air at a dull red heat, and the decomposition of the peroxide, by steam, at a lower temperature, even at 212° Fahr., with reformation of the hydrate of barytes—the process being in reality a continuous one.

It is found in practice advisable to mix the barytes with hydrate of lime or magnesia, so as to prevent the fusing of the first; this mixture, when placed in an earthen tube heated to dull redness, is to be oxidized by passing a current of dry atmospheric air over it. So soon as the oxidation is completed, the tube is connected with the gas-holder, and a jet of steam allowed to act upon it; this re-converts the peroxide of barium into hydrate of barytes, the excess of oxygen being given off and collected in the gas-holder. The barytes is then again oxidized by a fresh current of air, and deoxidized by steam, as frequently as required, thus making the process continuous. M. Boussingault considers that about 1000 cubic feet of pure oxygen gas could be obtained every twenty-four hours by the use of 10 cwts. of barytes, which will answer this purpose for any length of time.—*Mechanics' Magazine*, No. 1612.

REGULATION OF GAS.

A PATENT has been obtained by Mr. David Hulet, of High Holborn, for an apparatus for regulating the supply of gas to the burners, consisting of a cast-iron vessel, with inlet and outlet passages for the admission and emission of the gas. The inlet passage is covered by a valve, the edge of which dips into a groove containing mercury. The valve is attached by a rod to a short cylinder, the lower part of which is open, and also dips into mercury. This cylinder covers and surrounds the inlet, and, as the gas flows through it, exerts an upward pressure, which adjusts the supply.

IMPROVED LAMP.

THIS invention, patented by Mr. Deard's, of Harlow, relates to the application of spirit vapour lamps to railway-trains, and to those purposes generally where lamps are required to be moved through the air quickly; and the improvements consist of causing the wick of such a lamp to be enclosed in a tube which is perforated at its lower end, and which descends into the vessel containing the spirit. In order to prevent the strong currents of air coming against the upper part of the tube where the vapour is generated, and near where the vapour is ignited, the tube passes through a closed chamber, the lower part of which covers the opening into the vessel containing the spirit.

A NEW SAFETY MINING LAMP

HAS been invented by M. de St. Simon Sicard, and patented both in England and in France. It is an adaptation of the oxy-hydrogen lime light, and, unlike the "Davy" lamp, is hermetically sealed when placed in the hands of the miners. By a supplemental apparatus, this lamp, it is also said, can be made to light the whole of the galleries of a mine, thus placing the means whereby these accidents take place entirely out of the reach of the unskilled pitman.

LUCIFER MATCHES.

IT is stated in a recent work, that the manufacture of Chemical Matches occupies at Paris 20,000 workmen. Two preparers of wood for matches cut each day, by machinery, one eight steres of wood, and the other four. A single establishment makes 3,840,000 matches per day. That establishment consumes annually 1200 kilogrammes of phosphorus; and, according to M. Payen, that is scarcely the twentieth part of the production of phosphorus in France, and which is chiefly used for the same purpose. According to that estimate, internal consumption and exportation may be set down as requiring a supply per day of 76,800,000 matches!

LOCK-MAKING AND LOCK-PICKING.

MR. HOBBS has read to the Institution of Civil Engineers a paper "On the Principle and Construction of Locks." The author commenced by asserting, as an axiom, that the highest point of security to be attained in the construction of locks must consist in the fact, that the possibility of picking, or opening them, without their true keys, should depend entirely on chance; and that, notwithstanding the immense variety of locks already invented, there were really but three absolutely distinct principles involved in their construction,—so classed without reference to dates and for convenience of description. The first principle included all locks having a series of fixed obstructions, or wards, in and about the key-hole, to prevent any instrument except the key being turned in the lock; this principle was shown to be inefficient, however complicated the construction might be, as the wards themselves afforded the means of ascertaining the form of key required to open the lock. The second principle was

that of the Letter, or Puzzle Lock, which appeared to carry out the principle, or doctrine of chance, to the fullest possible extent. But in this case, also, a method was shown, by which the lock could be opened as easily as in the former; proving that the inventor of that class of lock had failed to accomplish the object of producing a fastening, whose security was dependent only on mere chance. The third principle, or last class of locks, including all those possessing a series of moveable pieces called slides, pins, tumblers, &c., placed within the case of the lock, and which pieces must be operated upon and moved into certain given positions, by a key, before the bolt could be shot. This principle was illustrated by descriptions of the Egyptian lock, the Bramah lock, the inventions of Barron and of Bird, the detector of Mitchell and Lawton, and the later improvements of Chubb and Cotterill (of Birmingham) and others. Allusion was then made to the great reliance which, until recently, had been placed on these locks, and an explanation was given of the principle on which all locks of this description could be as easily picked as their predecessors.

The author then commented on the necessity of devising some simple and effective means, by which the defect, common to all the above locks, might be remedied, without adding materially to the cost. This desideratum he had endeavoured to secure, by the introduction of what was called a moveable stump, which projection, instead of being rivetted into the bolt, was fixed to a piece, moving upon a centre, or pin, at the back of the bolt. The action of that piece was such as to render it impossible to ascertain the true position of the tumblers, for, on any pressure being applied to the lock for that purpose, the stump, by its motion, locked the bolt, and left the tumblers at perfect liberty. The author stated his conviction, that this apparently slight alteration, rendered it impossible to open such a lock, except by the mere chance or accident of a key fitting it; there being no possible means of ascertaining the form of key requisite to open it surreptitiously. Since the introduction of this lock, several attempts had been made to produce the same result, without actually copying the original, but with very little success. An additional principle of security, devised in America, was then pointed out, in the celebrated permutating bank lock, invented by Robert Newell, of the firm of Day and Newell (New York), of which invention Mr. Hobbs was the proprietor in this country. Previous to the introduction of that system, permutating keys had been used, but they required that the lock itself should be altered, to suit any new adjustment of the bits of the key, whereas, in the American lock, the key alone being altered, produced by its own action the corresponding arrangement in the lock. By this ingenious contrivance the person using the lock became his own lock-maker, and was able to render the key useless to any other person by a simple change in the bits after locking the door. Such locks, whose numbers of permutations varied from 720 to 479,001,600, according to the number of bits in the key, were intended principally for strong rooms of banks, and other establishments where large amounts of property were deposited; they

were, therefore, comparatively expensive, and were necessarily of larger size than locks required for ordinary use.

In respect to the locks alluded to in the paper, the author justified his statements by the two facts,—that he had not only elucidated the principles on which all such locks might be picked, but that he had actually performed all that had been described. Finally, a hope was expressed, that whatever had been done and said to enlighten the public as to the insecurity of many locks now in use, instead of causing any unpleasant personal feelings, would stimulate lock manufacturers to produce what was really required, viz., secure locks, adapted to all purposes, of good workmanship, and at a moderate price.

In the discussion which ensued upon the above paper, a succinct description was given of the various recent modifications generally introduced by makers of locks, and it was argued, that most of them were simply alterations of form, without materially adding to the security. An exception might, perhaps, be made in favour of Mr. Denison's lock; which was so constructed that the bolt was shot by turning a handle, without the intervention of a key, which in fact was only used for placing the tumblers in a proper position, to allow the bolt to be withdrawn, or unlocked, by the handle,—the key-hole being kept closed during the passage of the bolt; the key might, therefore, be always retained in the possession of one person, whilst the lock could be closed by any subordinate; this was important in banks and other similar establishments. The principle of the bolts being shot by a handle was not new, but the other arrangements were admitted to possess novelty. Mr. Whishaw's electro-magnetic lock, now exhibiting at the Polytechnic Institution, was explained. The principle of Mr. Cotterill's "patent climax detector lock" was then examined: it was asserted to be entirely based upon the Bramah lock, but was less secure in its arrangement, inasmuch as the form of the key admitted of so little variation in the depth of the grooves, for moving the slides,—that a lock, having six slides, might be opened by the end pressure of a piece of soft wood,—and that any lock, on that principle, with any number of slides, could be easily picked by the pressure system.

It was explained, that the American permutating lock, which had been fully described in the paper, was not intended for ordinary domestic purposes, but for banks and establishments requiring extreme precautions for security; and that the chief object in the introduction of Hobbs' moveable stump, or protector lock, was to supply a secure lock at a moderate price.

In the course of manufacturing, the weak points of this lock had not escaped detection, and it was soon discovered that, although the principle was correct, as long as the stump remained moveable, if, by any means, the stump could be held fast, the lock became one of the ordinary tumbler-locks, and was as easily picked as the others. For instance, in a till or drawer lock, where the key-hole was parallel to the bolt, it was easy, by the insertion of a piece of watch-spring beneath the lock, to catch and hold the stump, and to open the lock.

This, however, was prevented (it was said) by the insertion of a tongue in the back plate, fitting into a corresponding groove in the back of the bolt, thus cutting off all access to the moveable piece under the bolt; and further, to preclude access to the stump itself, a piece of steel was rivetted into the front plate, reaching through the tumblers into a groove in the bolt, thus placing an effectual barrier between the key-hole and the stump. With these slight additions, which were now introduced, it was contended, that locks constructed on the principle of the moveable stump might be considered secure. It was shown that Mr. Goater, who was connected with the establishment of Mr. Chubb, had succeeded very ingeniously in picking three of Hobbs's till-locks, by the means which had been described, those locks, however, not having the additions for security which had been alluded to. This opening of these locks was admitted to be perfectly legitimate.

The workmen employed by Messrs. Chubb and Son, at Wolverhampton, have presented Mr. Goater with a silver snuff-box, in commemoration of his great ingenuity in picking "Hobbs' Patent Unpickable American Lock." "Thus," says the Editor of the *Mechanics' Magazine*, (No. 1595), "the entire effect of Mr. Hobbs' continued efforts to bring English lockmakers and locks into disrepute has recoiled in its full severity upon himself. It is not to be expected that our countrymen will countenance a stranger who has employed himself unweariedly in attempting to divert their confidence and patronage from British manufacturers to himself, without securing the smallest additional advantage to them. But we have to complain not only of the fact that Mr. Hobbs has been furnishing the public, under guarantees of security, with locks which may readily and easily be picked, but also of the manner in which he has sought to evade the full force of Mr. Goater's manipulations."

THE MANUFACTURE OF GLASS.

In the course of a recent lecture on Glass at Sunderland, Mr. Hartley referred at some length to a "considerable social revolution" which arose through the abandonment of kelp and frit in producing the metal. Along the northern shores of Scotland and west of Ireland, a considerable population was employed in producing the article, one-half of which was kelp, and the other earthy matter, consisting of lime and charcoal. Till within the last twenty-five years this was employed, and the produce of glass was limited by the quantity of the article which was produced in the districts referred to. In those days its cost would be somewhere about 10*l.* per ton, but so great has been the change effected by the later improvements in producing the metal, that he had purchased a quantity of it a few months ago at only 3*l.* a ton. Mr. H. then noticed some of the ingredients which had been substituted for this article, and observed that iodine and soluble salts were now the more important components of the kelp. A great outcry, he said, had been raised against the proprietors in those distant quarters of the country, and they were charged with allowing the people on their estates to starve. If, however, persons were fully to investigate the cause, and exercise a little charity (and philanthropists themselves might be fairly included in this advice) instead of condemning the proprietors of those districts for their tyranny, it would be seen that the progress of

science—over which the proprietors had no control—had been the cause of much of the distress that prevailed; and if the efforts of the public had been employed to transfer the people to places where their labour would have been more valuable, a much better idea of the position of the parties would be obtained. As much as 150,000*l.* a year had been withdrawn from those districts, and the whole process superseded by a new description of alkali. This introduction was of so modern a date that the whole change had taken place since his connexion with the glass trade, and in the application of the new material he had taken an active part. Mr. Hartley then described the production which had taken the place of the natural alkali, and the various processes through which it passed. In explaining the model of the pot which stood on the platform, it was stated that the pots in use held one ton of material, and that in twenty hours their contents were converted from the raw mixture which had been originally put in, to a piece of plain transparent glass. Referring to the heat which was applied to the furnace, Mr. Hartley said that fully eighty per cent. of it was wasted; and with regard to the feasibility of the plans proposed for the consumption of smoke from glasshouses, he expressed considerable doubt as to the amount of saving which would accrue from the best of them.—*Builder*, No. 578.

MATERIALS FOR POTTERY AND GLASS.

Few are aware of the great importance of the common and superior Clays of this country to our manufacturers. The following statistical and other details are gleaned from the *Plymouth Times*. The Cornish and Devonshire china clays, or Kaolin (with two exceptions), come from the neighbourhood of Bodmin and St. Austle. At least 50,000 tons are annually prepared there for making porcelain, and sent off to the Staffordshire potteries in blocks as white as snow, packed in casks. An increased demand for the clays in question has sprung up of late years, in consequence of their use in calico-bleaching establishments, and in paper manufactories, many thousand tons being now used to give these substances an artificial body. About 25,000 tons of an inferior kind are raised at Boovey Tracey. This china stone is a semi-decomposed granite, but in a less advanced state of disintegration than the superior kind of clay. It is principally used as a glaze in the potteries. The total annual value of our earthenware manufactures is about 2,500,000*l.* sterling, of which we export about 1,000,000*l.* worth. About 750,000 tons of coal are annually consumed in making our ceramic wares, an amount equal to that used on the railways of the United Kingdom. The value of the gold consumed in the ornamentation of porcelain is estimated at 54,000*l.* The common potters' clay is used for ordinary earthenware. The estimated weight and value of the earthenware of all sorts made in the United Kingdom are 160,000 tons, and 3,500,000*l.* The exports for the last five years, in round numbers, were as follows:—53,000,000 pieces in 1848; 61,500,000 in 1849; 77,000,000 in 1850; 84,250,000 in 1851; and 89,000,000 in 1852; two-thirds of this quantity went to America. The dark Stourbridge clay is extensively

used in the manufacture of crucibles. The fine plastic white clay used for the manufacture of the common tobacco-pipe, of which the consumption is so immense, is derived chiefly from Purbeck in Dorsetshire.

DAYLIGHT REFLECTORS.

A VERY ingenious, yet very simple, invention has been introduced in the shape of the Daylight Reflectors patented by Messrs. Cappe and Co., of London. This is simply an application to daylight of the principle of taking advantage of reflected light which has been used for artificial lights from the days—to go no further back—of *sconces* downwards. The reflector consists of plates of corrugated glass covered on one side with a brilliant metallic coating; and it is placed at a window or other aperture by which light is admitted, being so adjusted as not only to catch the rays of light from the sky, but to direct them towards any particular spot within premises scantily supplied with daylight. In fact, by their use, in a naturally ill-lighted room, daylight can be turned off and on as readily as gas-light; and by multiplying the Reflectors sufficiently it can even be directed into corners that it had otherwise no chance of ever penetrating.

MELLISH'S PATENT PERFORATED PLATE-GLASS VENTILATORS.

THE great object to be accomplished in ventilation is the provision of an outlet for vitiated air, or an inlet for pure air, so nicely adjusted and arranged, that while these desirable results are attained, no unpleasant draughts shall be occasioned, nor any portion of light be intercepted. In the patent perforated pane of Mr. Mellish, he takes strips of plate-glass, varying from 1½ inches to 2 inches or more in width; and by means of revolving cutters he produces a series of notches in the edges of the strips, so that when put together to form a pane, they present a number of ornamental openings. The edges of the strips of glass, as well as the edges of the apertures, being bevelled and polished, they present an exceedingly beautiful appearance, arising from the play of the prismatic colours; especially if the sun's rays fall upon the pane, when the appearance resembles that of an elegant cut glass chandelier. The smallness of the apertures effectually breaks up any entering currents of air; an effect that is still further promoted by the bevelled edges of the apertures, which induce converging and neutralizing currents proportioned to the increasing force of the wind. These finely-perforated panes, which cause no projection, and are easily cleaned, admit both light and air, but exclude rain and dust; they form an ornamental and exceedingly appropriate finish for the upper part of plate-glass in shop-windows, permitting the escape of moist and heated vapours, injurious alike to the health of the inmates and the goods contained therein. Few shopkeepers have any adequate idea of the mischievous effects of heated air upon various kinds of goods. The rottenness induced, in hosiery goods for instance, stored on the upper shelves of gas-lit shops, is, however, one of the most serious character. The introduction of ventilators into pleasure-carriages is a decided novelty;

and to these the plate-glass ventilators of Mr. Mellish have been applied by Messrs. Davies and Son, with great advantage.—*Mechanics' Magazine,* No. 1605.

GRIBBON'S PATENT IMPROVEMENTS IN WINDOW-FRAMES AND SASHES.

MR. E. P. GRIBBON, architect, of Dublin, has patented an invention to remove the great objection to the window-frames and sashes now generally employed throughout the United Kingdoms,—viz., the inconvenience and danger arising from the necessity of cleaning and repairing windows from the outside,—the existence of draughts occasioned by loose beads,—and the expense of repairing the injuries done to the frames by the frequent removal of the beads. Mr. Gribbon's improvements can be applied to existing windows as readily as to new ones. The advantage of this will be instantly seen when it is remembered that if the number of windows be assumed only equal to the number of the inhabitants, and the value of each be estimated at 3*l.*, the capital at present represented by the windows of the United Kingdom amounts to about eighty millions of pounds. Any invention, the general introduction of which would require the cancelling of property to such an extent as is thus indicated, would not be likely to meet with any considerable patronage; and it is fortunate for the present inventor that he has avoided this objection, and has so satisfactorily adapted his invention to existing property.

Models of Mr. Gribbon's improvements have been exhibited before the Institute of British Architects, and met with a favourable reception.

The invention consists in constructing and fitting window-frames and sashes in such manner that the sashes can be unfixed and refixed, unhung and rehung by hand, without the use of a hammer and chisel or other instrument, and without unfixing the sash-beads. In carrying it into effect, Mr. Gribbon makes one pulley-style wholly or partially moveable, so as to widen the space between the two pulley-styles to such an extent as to allow the sash to be pulled clear out of the bead of the opposite pulley-style; and when both the upper and lower sashes are required to be unhung, he then makes both pulley-styles wholly or partially moveable in a similar manner, one for the lower, and the other for the upper sash. He fastens the weight-lines to the sashes by means of metal plates, having a slot, with an enlarged orifice at the bottom for receiving the knot at the end of the line, which then passes up the slot in the plate, and is thus held secure. In order to free the sash, the line must be pulled down until the knot reaches the orifice at the bottom of the slot in the plate, through which it will readily pass, so as to become detached from the sash. The line is prevented from chafing while the sash is hung by lying in a groove cut along the edge of the sash for that purpose.—*Mechanics' Magazine,* No. 1593.

FASTENINGS FOR WINDOWS.

THE *Rev. M. A.* Hyde, of Chester, has patented this invention,

which consists in the application to windows of certain self-acting mechanical apparatus, which, upon the closing of the window, draws the two sashes into close contact, and effectually secures them; thereby simultaneously preventing draught and shaking of the sashes, and also keeping the same closed until released by hand. The self-acting mechanical apparatus may be constructed as follows:—One part or sash of the window is furnished with an inclined plane or projection, over which an inclined loop or staple falls upon the closing of the window; the action of these two inclined planes bringing the two sashes of the window into close contact. The staple is provided with a small spring-bolt that shoots into a catch or notch formed upon or in the inclined projection, thus securing the two sashes until the bolt is withdrawn by hand; or (if preferred) the spring-bolt may be attached to the inclined projection, and the catch or notch be in or upon the staple. This is all the apparatus that is necessary, provided that the sashes have no transverse sash-bars or other similar transverse projection. Where the reverse is the case, it is necessary that the projecting staple and its appendages should be mounted upon slides, being so constructed and acted upon by a spring as to slide back out of the way upon passing any of the sash-bars or projections, and return to its original position immediately after having passed the same.

DOMESTIC TELEGRAPH.

Dr. Albert, of Paris, has patented this instrument. The inventor places a dial-plate in front of his apparatus, and has marked upon this plate a certain number of letters, figures, or other signs, corresponding with the several apartments of the building. When the instrument is at rest, each of these is concealed by means of a small sliding-plate or shutter, which is connected by a pin to a sliding-rod furnished with a retaining-spring; and to the upper end of the sliding-rod is attached a wire or cord communicating with one of the apartments of the building. The lower end of the sliding-rod passes through a bar which is connected by means of any ordinary self-adjusting escape-movement to the hammer of a bell, in such manner that the raising of any one of the rods will cause the hammer to strike the bell. The rising of the rod, caused by pulling the wire in any of the apartments, at the same time exposes to view its respective figure, letter, or sign, so as to indicate to the servants from which apartment the call is made.

THE CONICAL FLOUR-MILLS.

This most valuable invention* has been making rapid progress at home and abroad. The Austrian patent has been sold for 30,000*l.* A large mill has been erected at Vienna, and is in full work. Another has been built for Lord Portman, at Bryanstone, Dorset, which grinds 8½ bushels per hour against an ordinary mill belonging to his lordship, which grinds 2½ bushels, and the same power (water) does for both. The magistrates of Hampshire have erected a mill in the

* *Described in Year Book of Facts*, 1854, p. 119.

county gaol at Winchester, and in Ireland Lord Talbot de Malahide, the celebrated Mr. Dargan, and others, take a most lively interest in its adoption in that country. In France, Prince Murat has become the president of a committee, consisting of the Marquis de la Rochejacquelin and other eminent men, to carry it out. New foreign patents are continually being obtained.—*Liverpool Mercury.*

MEAT BISCUIT.

We read in the Paris *Cosmos*:—"For some years past there have been imported large quantities of dried meat from the southern countries of America, where it is known under the name of *assayo.* It gives a soup nearly similar to that of fresh meat. Another sort of food which is prepared in Texas, the *Meat-Biscuit,* is generally used in the American navy; but although greatly appreciated at the Exhibition of London, it has not yet entered into general use in Europe. It is made from boiled beef, free from grease, the liquor of which is evaporated to the consistency of syrup, and this is mixed with wheaten flour in sufficient proportion to form a solid paste. This paste is then spread out by a rolling-pin, is pierced with a number of little holes, is cut into the ordinary dimensions of sea-biscuits, and is then baked and properly dried. The biscuit is eaten dry, or may be broken, boiled in twenty or thirty times its weight in water for from twenty-five to thirty minutes, and be seasoned with salt or other things. In France, where there are not, as in America, large quantities of animals, which are killed simply for the sake of their hides, it would be impossible to prepare or give at a low price either the assayo or the meat biscuit. But the idea of using the blood of animals killed, which blood is at present wasted without profit, or at best is used as a manure, might have occurred to some one. M. Brocchieri had conceived this idea. In treating the blood of our slaughter-houses by means which he has invented, and uniting to flour of the best quality the albumen and fibrine which he extracts from it, he makes bread and biscuits which are easily preserved, and which may be employed to make very nutritious soups. This preparation contains, according to the inventor, one-half of the azote of the blood consumed."

NEW PROCESS OF MAKING BREAD.

MM. Journet and Martin, of Paris, have discovered this New Process, which has been shown by experiment at the bakery of the Marylebone Workhouse, with the following results:—

"Two sacks, which had been previously sealed, were taken from the store and used on this occasion.

"By the ordinary process the flour yielded, before baking, 90 loaves, 4lb. 7oz. each, which, after having been baked, gave a net weight of 360lbs. of bread.

"By the new process the flour yielded 136 loaves of the same weight which, having been baked, gave 529lbs. of bread. Thus numerically *the yield was as* 90 to 136, or about 51 per cent. in *favour of the new process*; and in weight, as 360 to 529, or above *47 per cent. in favour of* the new process.

"The difference between the 47 and 51 per cent. in weight would have been yielded if all the loaves had been made of the same shape (the ordinary shape used in the workhouse); but as nearly one-half was made in long and round loaves, exposing a larger surface to the heat of the oven, a much greater loss of weight was sustained by them in the baking, than by the other portion, which was of the usual shape."

Every one, except Messrs. Journet and Martin themselves, seemed, not only satisfied, but astonished at the result. Those gentlemen, although they only profess an economy to the extent of 50 per cent., stated that they had, on experiments made for six weeks continuously in Paris, never obtained less than 58 per cent. The experiment had also occupied much more time than they expected and was hurried at last, so that they did not consider the bread so perfectly baked as it should have been. For these reasons they requested permission of the Board of Guardians and Directors to permit them to make another experiment with half the quantity of flour, so as to take less time. The Board at once granted permission, and the second experiment was made on the 5th inst., the result being as follows:

"Half a sack of flour, weighing 140lbs., was delivered from the workhouse store, to which the fermentive material of M. Journet was added, and thoroughly mixed. The dough being thus formed was made up and baked in the ordinary manner, the produce being 68½ loaves, each of the average weight of 4lbs., or rather upwards; whereas by the usual mode of making bread, only 45 loaves of equal weight would have been produced, the increase being at the rate of rather more than 52 per cent."

It is only fair to mention that the flour used on both occasions was 2nd of No. 2, such being the quality ordinarily used at the workhouse. Had the flour been of the first quality, M. Journet states the result would have been still greater.

M. Journet professes from a given weight of flour, to make 50 per cent. more bread than can be made by the ordinary system, at an expense not exceeding four shillings per sack of flour or an increase of 45 loaves, of 4lb. each, for four shillings.

Without knowing what the materials composing the secret ferment are, we have the statement of Messrs. Journet, Martin and Monin to rely upon as to the cost of it; and their assertions as to the increased quantity produced from a sack of flour have been fully and fairly demonstrated by the results of the above two experiments.

These results, the importance of which it is difficult to over estimate, seem at first almost incredible, and the idea naturally occurs that something is added to the flour to directly increase the weight, just as sand is added to soap, forming what is called "sand soap." M. Journet's discovery does not appear to be of this nature, insomuch as the most careful analysis fails to discover in the bread made by his process any materials other than such as are invariably found in good bread.

Subsequently to the first experiment, Dr. Sayer had been requested by several members of the Board of Guardians, to satisfy himself

by examination and analysis, as to the purity of the bread; and that gentleman expressed himself much satisfied with the result, not a trace of any foreign matter having been discovered.—*Mr. P. Graham; Journal of the Society of Arts.*

ICE-MAKING MACHINE.

THIS American invention has been patented in this country. The principle on which the machine acts has been long known, viz., that air when compressed, gives out its heat, and in expanding absorbs it, rendering it latent. In the machine, air is compressed by a powerful pump, and the heat it gives off during compression is taken up by jets of water. This air then passes into a receiver, where it is separated from the water, and from the receiver enters a cylinder provided with a piston, in which it expands gradually. The expansion force is utilised by the agency of the piston, whose rod is connected with that of the compressing pump in such a manner, that the dilation of one portion of the air aids in compressing another portion just entering the machine. As the air expands, it cools, or, to speak more accurately, it abstracts caloric from a supply of liquid congealable only at a low temperature, such as brine, spirits, &c., which surrounds the dilation cylinder, and also enters the same in a jet, and finally escapes into the outer air. The fluid thus cooled circulates in a tank round the vessels containing the water to be frozen, and extracts the heat therefrom, returning again to be cooled in the expanding cylinders. That ice may be thus produced and in considerable quantities, admits of no doubt—the question to be solved is the cost of production; and this resolves itself into wear and tear of machinery, and consumption of fuel to drive it. It is said that the experiments show that large quantities of ice may be made at a comparatively low cost.—*Journal of the Society of Arts*, No. 66.

CANDLE-MAKING.

MR. J. F. WILSON, Managing Director of Price's Candle Company, of Vauxhall, and Mr. A. J. Austen, of Wandsworth Road, have patented certain improvements in the apparatus used in the manufacture of mould-candles. The inventors cover and protect the glass-tubes with gutta-percha, either by wrapping and moulding around them a piece of sheet gutta percha, and using heat to join the edges together; or by enclosing the glass pipe in a piece of gutta percha tube of the requisite size, then applying heat, so as to enable the one end to be moulded about the tip of the glass, and so as to apply the gutta percha firmly to the glass in all parts; or, they draw over the glass tubes a piece of vulcanized India-rubber tube of the necessary size; or they cover the tubes with a composition capable of being applied in a partially fluid or pasty state, and of hardening into a more or less firm body when dry.

Since we detailed the operations of Price's Candle Company, at Belmont, Vauxhall, in the *Year-book of Facts*, 1850, the Works have acquired additional importance in a commercial point of view, as well as in their becoming a sort of model establishment, in which it has been shown that advance towards the highest principles of Christian faith and love have been co-existent with their industrial

progress. The manufacture has constantly advanced: new English, French, and latterly a highly promising American process have been brought forward, only, however, to be superseded by a new development of the Company's resources. They now employ 2000 persons; their capital is 700,000*l.*; called up 612,000*l.* Their operations have been considerably affected by the War: for example, the importation of palm-oil—the raw material of stearic candles—has increased about one-fourth of the whole quantity, which fourth is equal to one-eighth of the tallow brought to England from Russia. In addition to the Company's factory at Belmont, extending over nearly two acres, with large branch works at Battersea, another factory has been established near Liverpool, the chief port of importation for palm-oil. The scene of these new operations is Bromborough Pool, on the Mersey, about four miles above Birkenhead. Here has been built a factory with walls 20 feet high, roofed with galvanized corrugated iron, in spans of 40 feet, covering 3¾ acres.

The fourteen steam-boilers are fitted with self-feeding, smoke-consuming furnaces. The stoke-hole is nearly 300 feet by 80; the engine-house contains a pair of 20-horse horizontal, high-pressure, expansive, and condensing engines, by E. A. Cowper. This increased extent of manufacturing power will lead to the reduction of prices, so as to meet the enormous demand which has sprung up from Australia, and relieve us from any fear of the French interfering with our trade in the home or export markets, of which, at one time, there were symptoms.

The works include shops for the principal trades employed—engineers, smiths, copper-smiths, tinmen, coopers, carpenters, bricklayers, and weavers; and gas-works. It seems rather absurd that candle-makers cannot light their own premises, but, whatever gas may be in closed rooms, for great open buildings it is of course the cheapest and safest light.

One point connected with the new works, much to be regretted, is that their mode of construction, and the way in which the processes are worked, prevent the admission of visitors.

THE SILK MANUFACTURE.

MESSRS. CHADWICK AND DICKINS, of Manchester, have patented certain "Improvements in the Production of Raw and Thrown Silk." Their invention may be popularly described as a mode of spinning from cocoons directly on to a bobbin: in other words, they can produce direct from cocoons, and wind upon bobbins, silk in precisely the same state as that arrived at after the third process of the throwstering trade. They therefore avoid all the injury and cost of bad reeling abroad, and the trouble of subsequently opening the books; thus substituting one process for three. A number of cocoons are placed in a trough of soap and cold water, and they remain there until shortly before they are wanted for use. A girl then lifts them with a ladle into a trough of boiling soap and water, where they are left for a minute or so. By these means the cocoons are thoroughly softened, and the gummy matter which causes the silk to adhere to the surface is dissolved. They are thereafter removed to the cold water; and the girl, taking a number of them in one hand, seizes with the other the floss or waste silk, and after a few draws, secures the "master thread" of each. The cocoons are then placed in a small trough at the end of the frame, with the threads hitched up, so that any cocoon may be readily removed for reeling or spinning. Along the upper part of the frame is a table, upon each side of which rests the trough, divided into thirty compartments. The troughs contain water, heated by steam to about 120° Fahrenheit. In each division are six cocoons, bent wires being placed to prevent any cocoon rising out of the water as the threads are drawn off. The filaments from each six cocoons pass between the wires over their particular com-

partment, join, and then pass over a roller, or a wire covered with a soft material; thence the threads are conducted down the front to the lower range of the frame, where, by means of ordinary bobbins and flyers, they are at once spun and reeled, and are ready for any of the processes necessary for converting singles into tram or organzine. If a thread breaks, the particular bobbin and flyer can be instantly stopped, without interference with any of the others, each being fitted with a slight catch motion, ready to the hand of the attendant; if a single filament breaks, very slight practice enables the attendant to detect it, in passing from end to end of the frame, owing to the cessation of the slight dancing motion imparted to the cocoon as the filament is withdrawn. We are told that the average length obtained from ordinary Chinese cocoons is about 600 yards; and that owing to the peculiar way in which the worm places the silk as produced (somewhat in the form of a continuation of the figure 8), the actual position of a cocoon in the water is changed very gradually. It is generally considered, on the Continent, to be a very good result, when 1lb. of silk has been obtained from 4lb. of cocoons. Messrs. Chadwick and Dickins say they are certain that their invention will produce a greater comparative weight of good silk; and that they can also effect a saving of several shillings per pound, as compared with the cost of the ordinary process of throwing. They also state that they can wind upon a bobbin, from a succession of single cocoons, a length sufficient for a pound of silk; the thread in that case being 600 miles long, or equivalent to about No. 1257's in cotton spinning. In addition, the patentees claim that by their process they will be enabled to produce from inferior cocoons, whether from India, China, or elsewhere, the best silk; far surpassing, indeed, for all purposes of manufacture, the most superior qualities now obtained from India or China. —*Abridged from the Manchester Guardian.*

NEW CALCULATING MACHINE.

THE Abbé Moigno has presented to the British Association a new Arithmometer, or Calculating Machine, by M. T. De Colmar. The machine, which was very beautifully executed, consisted of an oblong box, about 30 inches long by 6 inches wide. On the face, the machine was furnished with a handle to turn round a number of small holes, at which the digits of the common arithmetic scale, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, made their appearance as the machine worked, and which finally gave the answer. In this machine they were eight in number, but they might be extended to any number. To each of these was an index to be set to the required digit, engraved on a small attached vertical scale, and a small ivory ball to be moved along its scale according to certain simple rules, as the operation to be conducted by the machine varied from addition to multiplication, &c. Upon drawing out the sliding bottom of the machine, the machinery was exposed to view. This, though simple, could not be intelligibly explained without the machine or diagrams. The chief part of it consisted of eight cylinders so arranged that, as they turned, the digits, enamelled on a circle at their upper parts, came in succession to the holes in the face: while by a number of indentations

arranged spirally round them, the digit to which the index was set would be stopped at the hole on the face at the digit corresponding to that at which the index was set; while by a set of pinions a connexion was given to them something similar to that in the common bank-note machine, so that addition could be performed and the result appear on the face:—thus by turning the handle once, the number itself appeared; by turning it twice every digit in it was doubled, and the result appeared above as twice the number originally set, and so on with any multiple of the number so set; then by moving the ivory ball any simple multiple of 10 times, 100 times, 1000 times, and so the number set could be obtained and added to those previously obtained, and thus the operation of multiplication performed of any number by any number to the extent the machine could give, in this case up to 99,999,999, or nearly 100,000,000. The Professor then exemplified this, by setting a large number and multiplying it by a number which consisted of three digits. He next explained how the other operations were to be performed,—showing that the machine could add, subtract, multiply, divide, raise to an integer power, or extract the square or cube root with precision and rapidity. The price of the machine exhibited was 50*l.*—*Athenæum*, No. 1408.

INSTITUTION OF CIVIL ENGINEERS.

THE Council have awarded the following premiums:—A Telford Medal, to Nathaniel Beardmore, for his "Description of the Navigation and Drainage Works, recently executed on the Tidal portion of the River Lee." A Telford Medal, to Andrew Henderson, for his paper "On the Speed and other properties of Ocean Steamers, and on the Measurement of Ships for Tonnage." A Telford Medal, to John Pigott Smith, for his paper "On Macadamized Roads, for the Streets of Towns." A Telford Medal, to Alfred Charles Hobbs, for his paper "On the Principles and Construction of Locks." A Telford Medal, to James Yates, M.A., F.R.S., &c., for his paper "On the Means of attaining to Uniformity in European Measures, Weights, and Coins." A Council Premium of Books, suitably bound and inscribed, to John Thornhill Harrison, for his paper "On the Drainage of the District South of the Thames." A Council Premium of Books, suitably bound and inscribed, to Daniel Kinnear Clark, for his "Description of the Deep Sea Fishing Steamer, *Enterprise*, with Ruthven's propeller." A Council Premium of Books, suitably bound and inscribed, to James Simpson, Jun., for his paper "On the Prevention of Smoke, in Engine and other Furnaces." A Council Premium of Books, suitably bound and inscribed, to William Michael Peniston, for his paper "On the Casualties of Tunnelling, with Examples." A Council Premium of Books, suitably bound and inscribed, to David Chadwick, for his paper "On Water Meters."

Among the additions to the library of the Institution should be mentioned the bequest of the late Mr. B. L. Vulliamy, of Pall Mall, of a large and very valuable collection of works on Horology, second only to the collection in the library of the Clockmakers' Company.—*See Curiosities of London*, by the Editor of the present volume, *pp. 368, 459.*

Natural Philosophy.

THE GYROSCOPE.

M. FOUCAULT has communicated to the British Association "Nouvelles Expériences sur le Mouvement de la Terre au Moyen du Gyroscope." The author spoke in French, but very distinctly, and the apparatus was so simple, beautiful, and exquisitely constructed, that the experiments all succeeded to a miracle, and fully interpreted the author's meaning as he proceeded. The Gyroscope is a massive ring of brass connected with a steel axis by a thinner plate of the same metal, all turned beautifully smooth, and most accurately centered and balanced; in other words, the axis caused to pass accurately through the centre of gravity, and to stand truly perpendicular to the plane of rotation of the entire mass. On this axis was a small but stout pinion, which served when the instrument was placed firmly on a small frame, containing a train of stout clock-work, turned by a handle like a jack, to give it an exceedingly rapid rotatory motion on its axis. But to this clock-work frame it could be attached or detached from it instantly. This revolving mass was only about 3 inches wide, and four of them were mounted in frames a little differently. The first was mounted in a ring, attached to a hollow sheath, which only permitted the axle and the pinion to appear on the outside, so that it could be laid hold of, or grasped firmly in the hand, if the pinion were not touched, while the mass inside was rapidly revolving without disturbing that motion.

By this modification of the Gyroscope, the author afforded to the audience a sensible proof of the determination with which a revolving mass endeavours to maintain its own axis of permanent stable rotation; for upon setting it into rapid rotatory motion, and handing it round the room, each person that held it found himself forcibly resisted in any attempt to turn it round either in his fingers, or to the right hand or left, or up or down, or in his hands, if he swung it round. So that the idea was irresistibly suggested to the mind, that there was something living within which had a will of its own, and which always opposed your will to change its position. The second modification presented the mass suspended in a stout ring, which was furnished with projecting axles, like the ring of the gymbal. These axles could be placed in a small frame of wood bushed with brass. This small frame, when placed on a piece of smooth board, could be turned freely round by turning the piece of board on which it rested as long as the gyroscope was not revolving, friction being sufficient to cause the one to turn with the other; but when the gyroscope was set rapidly revolving, in vain you attempted to turn the frame, by turning the board on which it rested, so determinately did it endeavour to maintain its own plane of rotation, as quite to overpower the friction. In the third modification of the gyroscope it was sus-

pended in gymbals so exquisitely constructed that both the gyroscope proper and the supporting gymbals were accurately balanced, so as to rest freely when placed in any position in relation to the earth. By this the author showed most strikingly the effect of any attempt to communicate revolving motion round any other axis to a mass already revolving; for, on placing the gymbals in a frame of wood while the gyroscope was not revolving, it remained quite steady; but when thrown into rapid revolving motion, the slightest attempt to turn the frame round to the right or to the left was instantly followed by the entire gyroscope turning round in the gymbals, so as to bring its axis to coincide with the new axis you endeavoured to give it, with a life-like precision, and always so as to make its own direction of revolution be the same as that of the slightest turn you impart to it. Having thus demonstrated the necessary effect of combining one rotatory motion with another, he then proceeded to demonstrate palpably that the earth's revolving motion affected the gyroscope in precisely a similar way. Having, by the screw adjustments, brought the gyroscope, in gymbals, to a very exact balance, it remained fixed in any position when not revolving. But, rapid rotatory motion having been communicated to the gyroscope mass as soon as the gymbal supports are placed on the stand, you see the entire apparatus, slowly at first, but at length more rapidly, turn itself round, nor ever settle until the axis, on which the gyroscope is revolving, arranges itself parallel to the terrestrial axis, in such a sense as to make the direction of the revolving gyroscope be the same as that of the whole earth. He next showed that the determination with which it did this was sufficient to control the entire weight of the instrument, though that amounted to several pounds; for, taking the ring gyroscope, from the side of the ring of which a small steel wire projected, ending in a hook, the wire coinciding with the prolongation of the axis of the gyroscope; of course, when not made to revolve, the hook, if placed in a little agate cup at the top of a stand, would permit the instrument, by its weight, to fall instantly, as soon as the support of the hand was taken from it. But, upon imparting to it rapid rotatory motion, it stood up even beyond the horizontal position, so as to bring its axis of rotation nearly to the same inclination to the horizon as the axis of the earth, while the whole acquired a slow rotatory motion round the point of the hook; and so steady was its equilibrium while moving thus, that a string being passed under the hook and both ends brought together in the hand, the whole may be lifted by the cord off the stand, and carried revolving steadily about the room. Next, to show the motion of the earth sensibly, he placed the gymbal gyroscope suspended freely by a fine silk fibre in a stand with the lower steel point of its support resting in an agate cup; a long light pointer projecting from the ring carried a pointed card, which passed over a graduated card arch of a circle placed concentrically with the gyroscope; upon imparting rapid rotatory motion to the gyroscope the index was seen as the earth moved to point out the relative motion of the plane of rotation exactly in the same way; the law of

the motion being also the same as that of the well-known pendulum experiment. Lastly, he set the ring gyroscope in motion, and by placing a small pointed piece of brass at the end of the axle on the ring, the instrument went immediately through all the evolutions of a boy's top on the floor, humming meanwhile loudly also.

These beautiful and most decisive experiments were received most enthusiastically by the Section; and, at their close, a request was made to the Committee of the Section to solicit the officers of the Association to have them repeated at one of the evening meetings before the assembled Association. This having been acceded to, they were repeated in the Great Hall of St. George's Hall, Dr. Tyndall interpreting M. Foucault's French as he proceeded; and they were again repeated in the Committee-room of Section A, to a select number of the *savans*. In the course of this exhibition, Lord Harrowby suggested that there was a mechanical compass needle quite free from the derangements of magnets. To this Dr. Whewell and some of the others seemed to assent, although fears were expressed that the motion of a ship would not allow of its use on board.—*Athenæum*, No. 1406.

ROTATORY MOTION.

PROFESSOR POWELL has explained to the Royal Institution, in a popular manner, the abstruse subject of "Certain Paradoxes of Rotatory Motion," which have much occupied the attention of scientific men on the Continent. He commenced by observing that the present age might be termed the age of rotation: two years ago we were all watching the rotation of the earth by means of Foucault's pendulum experiment; last year our heads were turned with turning the tables; and now the special advantages of Rotatory Bullets are undergoing investigation; accordingly, our soldiers have gone out to shoot the Russians, armed with the Minié rifle. It was on this account, he said, that he had chosen for his subject some curious and interesting circumstances connected with Rotatory Motion, which might be justly termed paradoxes, and which, although they have been known and investigated on the Continent, are very little known in England. Professor Powell said he had been often asked whether his subject was connected with table-turning, and he begged to say he did not pretend to deny or to affirm that some of the facts he should mention might or might not be supposed to have reference to the rotation of tables, though they were certainly not directly applicable. A German philosopher, Ferrell, had made many interesting experiments on the influence of rotation on bodies, which led to the conclusion that the effect of communicating rapid rotatory motion is to diminish weight. He constructed an instrument consisting of a horizontally suspended bar, having a wheel at one end to which rotatory motion could be given. When the point of suspension was shifted so as to make the wheel end the heavier, the horizontality of the bar was restored *by communicating motion* to the wheel, and so remained as long as *the wheel was kept turning*, but as the speed of rotation diminished,

the wheel end gradually dropped down. Instead of descending perpendicularly, however, it leaned on one side. This experiment was shown by a wooden model, large enough to be seen by the whole audience; also by a beautiful apparatus of Professor Wheatstone's which exhibited the phenomenon more satisfactorily. It appeared from this experiment, that a body rotating is lighter than a body at rest; and thus, as Professor Powell remarked, a leg of mutton when roasting weighs less than when brought to table. Another apparatus, contrived by Professor Wheatstone, for illustrating the same phenomenon, was exhibited with similar results. Adverting then to another branch of the subject, Professor Powell noticed some experiments recently made in the Prussian army with missiles of a cylindrical shape with conical apices, the directions of which were found to vary with the amount of propelling charge, When the charge was low, those missiles deviated to one side. This fact was illustrated experimentally by means of paper shuttlecocks. Professor Powell also exhibited some card-board bomerangs, the return of which to the point from which they were propelled, he instanced as one of the paradoxes of rotatory motion. He said he thought these various paradoxes might be explained by a body when acted on by two forces in different directions, the resulting motion being a compound of the two. He stated, however, that many scientific men differed from him as to the cause. He believed that the precession of the equinoxes might be accounted for by these paradoxes of rotatory motion. The star Alpha Draconis was to the ancients the Pole star, and was inclined to the earth at an angle of twenty-six degrees, exactly as the inclinations of the pyramids at the time they were built; and those stupendous relics of past ages might thus be regarded as gigantic observatories by which Pharaoh's astronomer royal regulated his chronometers.—*Morning Chronicle.*

MAGNETIC HYPOTHESES.

PROFESSOR FARADAY has read to the Royal Institution a paper, the particular object of which was to caution the investigators of scientific truths against placing too much confidence on any hypothesis. Every year of increased experience had taught him more and more to distrust the theories he had once adhered to; and his present impression with regard to existing Magnetic and Electrical Hypotheses was, that they were very unsatisfactory, and that the propounders of them had been following in a wrong track. As an instance of the obstacles which erroneous hypotheses throw in the way of scientific discovery, Professor Faraday adduced the unsuccessful attempts that had been made in this country to educe magnetism from electricity, until Oersted showed the simple way. He said that the identity of magnetism and electricity had been strongly impressed upon the minds of all: when he came to the Royal Institution, as an assistant in the laboratory, he saw Davy, Wollaston, and Young trying by every way that suggested itself to them, to produce magnetic effects from an electric current; but, having their minds diverted from the true course by their existing hypotheses, it

did not occur to them to try the effect of holding a wire, through which an electric current was passing, over a suspended magnetic needle. Had they done so—as Oersted afterwards did—the immediate deflection of the needle would have proved the magnetic property of an electric current. Professor Faraday showed that the magnetism of a steel bar is caused by the accumulated action of all the particles of which it is composed, by first magnetising a small steel bar, and then breaking it successively into smaller and smaller pieces, each one of which possessed a separate pole; and he said the same operation might be continued until the particles became so small as not to be distinguishable without a microscope.

It being admitted that magnetic power resides in the ultimate particles composing a magnet, various hypotheses had been proposed to explain how those particles possess this power, which may be given to them either temporarily or permanently by electricity. He mentioned the hypotheses of Davy, Berzelius, and Ampère, and showed that none of those fulfilled all the conditions of a satisfactory explanation. The theory of Ampère was particularly dwelt upon, on account of the favour with which it has been received. His hypothesis is, that electric currents surround every molecule of a magnet, and are constantly circulating round it; and that the difference between a bar of iron before and after it is magnetized is, that in the former the electricity is in a quiescent state, and that in the latter it is in a state of rapid rotation round each particle. Professor Faraday pointed out several objections to this hypothesis, which he said is not reconcilable to the various methods by which magnetic action is induced, nor to the phenomena of diamagnetism, some of which he exhibited. De la Ruce had attempted to remove the difficulties by supposing that the electric currents circulate round the particles in various directions, and that when a bar of soft iron is magnetised by electricity, the particles which were previously placed irregularly assume a polar arrangement. It is, indeed, a remarkable fact, which has been adduced in support of this hypothesis, that a movement does take place among the particles of iron when a bar is magnetised, as proved by a peculiar sound issuing from it the instant that contact is made with the voltaic battery, and also by a slight elongation of the bar of iron. This experiment was successfully performed; the cracking sound of the iron bar, surrounded by a helix of insulated copper wire, being distinctly audible. Professor Faraday, however, said he was less inclined to believe the hypothesis of De la Ruce than that of Ampère; and he would as soon return to the exploded theory that the earth is the centre of the solar system, as adopt anything so fanciful as that of variously circulating electrical currents round the particles of matter. In conclusion, Professor Faraday read some passages from Newton's letters to Bentley, to show how cautiously that great philosopher avoided forming any hypothesis as to the nature of gravitation; he strongly recommended all inquirers after scientific truth to follow such an example, and not to be trammelled by any hypothesis, however feasible it might seem.—*Morning Chronicle.*

THE MAGNETIC FLUID.

PROFESSOR TYNDALL has made to the British Association a communication "On some Peculiarities of the Magnetic Field." The author showed first that diamagnetic bodies may, through the influence of structure, set their largest dimensions from pole to pole; and that magnetic bodies, from a similar cause, may set their length at right angles to the line joining the poles. But this takes place only when the distribution of the magnetic force is tolerably uniform. Suspended between the *pointed* poles of an electro-magnet, a bismuth bar which between flat poles would set axial, will, owing to the repulsion of its two ends by the points, recede to the equatorial position. But when it is lifted out of the sphere of this local repulsion, when it is raised to a certain height above the points, the directive influence due to structure predominates, and the mass sits once more axial. The complementary phenomena are exhibited by a magnetic bar, which, in virtue of its structure, sets between the flat poles, its length at right angles to the line uniting them. Suspended between the points, the attraction of its ends causes the bar to be pulled into the axial position; but when removed from the influence of the local attraction, it turns and sets its length equatorial. The law of those rotations, which have caused much complexity of thought, was deduced from a great number of experiments with bodies, where the directive tendency due to structure was caused to act in opposition to the influence of length. Between the points such bodies, when diamagnetic, set equatorial, above and below the points, axial; if the body be magnetic, it sets between the points axial, above and below them, equatorial. A singular distribution of the magnetic force in the space between two flat poles was demonstrated by other experiments executed by Prof. Tyndall. He showed that a homogeneous diamagnetic bar, suspended exactly central in such a space, always sets its largest dimensions from pole to pole; thus showing that the axial line from centre to centre of the poles is, contrary to the opinion universally received hitherto, the line of minimum force. A most interesting discussion, in which Prof. Faraday, Dr. Whewell, and Prof. Thomson joined, followed this communication.—*Literary Gazette*, No. 1969.

GALVANIC CURRENTS.

M. GASSIOT has exhibited to the British Association some beautiful experiments on the Heating Effects of Secondary Galvanic Currents. He alluded to the fact previously observed, that in experiments made with Rumkorf's induction-coil, the heating effect takes place in the contrary direction to that which is produced in the primary current. He proceeded to illustrate the following conclusions: that if the discharge take place in air, or in a wide tube, the negative terminal becomes heated; if the wires be sealed into small straight tubing, a discharge, without heat, takes place, filling the tube with a brilliant white light; and if a bulb be blown in the tube, the discharge passing through it spreads with a brilliant blue light. Mr. Crosse also brought before the Section an account of a number of experiments,

the most important of which had reference to the slow deposition of crystals by electro-galvanic agency, which tended to throw some light on the formation of crystalline carbonate and sulphate of lime or baryta, and other minerals, in various rocks.

DIAMAGNETIC FORCE.

PROFESSOR TYNDALL has communicated to the British Association, and illustrated experimentally, some of the results of an inquiry on the Diamagnetic Force. With regard to the nature of this force, the greatest diversity of opinion prevails: in Germany we have Weber affirming that diamagnetic bodies possess a polarity opposite to that of ours; Von Feilitsch, on the contrary, affirms that the polarity of magnetic and diamagnetic bodies is the same; while in this country Professor Faraday, and it is believed Professor Thomson, are not prepared to accept the notion of diamagnetic polarity at all. In the present investigation it was attempted to obtain clear and certain evidence as to the nature of diamagnetism: the author first proved that the repulsion of bismuth was due to a temporary state of excitement into which it was cast by the influencing magnet, the strength of this excitement varying with the strength of the magnet. It was next proved that the condition noted by one magnetic pole was different from the condition noted by a pole of the opposite quality, and from this the presumption was derived that the diamagnetic force was *dual* in its character. An inquiry was next instituted into the deportment of diamagnetic bodies when operated on—firstly, by the magnet alone; secondly, by the electric current alone; and, thirdly, by the magnet and the current combined. It was shown that the greatest errors might be committed if, in studying magnetic and diamagnetic phenomena, the influence of structure were not taken into account. A normal diamagnetic bar always exhibited a deportment precisely antithetical to that of a normal magnetic bar; but, by taking advantage of structure, it was possible to get diamagnetic bars which exhibit precisely the same deportment as normal magnetic ones, and magnetic bars which exhibit a deportment precisely similar to normal diamagnetic ones. An abnormal bar of either class showed a deportment perfectly identical with the normal bar of the other class; the antitheses, however, subsisting between normal bars of both classes, and between abnormal bars of both classes, lend strength to the presumption that whatever the nature of the influence may be to which the attraction of soft iron is to be attributed, to an influence of the same nature, but antithetical in its manner of distribution, the repulsion of diamagnetic bodies is to be referred. Following up the inquiry, and entering into a thorough comparison of magnetic and diamagnetic phenomena, the author showed that the deportment of both was throughout antithetical. A certain disposition of forces would cause the ends of an iron bar to be attracted; the same disposition would cause the ends of a bismuth bar to be repelled; while that combination of forces which produced the repulsion of the iron bar, produced the attraction of the bismuth one. The experiments, *without exception, go to prove* that the diamagnetic force is a polar force, and

that its direction is opposed to that of the force in ordinary magnetic bodies.—*Literary Gazette*, No. 1970.

CAST-IRON FOR ARTIFICIAL MAGNETS.

M. CRAHAY found, several years ago, that Cast-Iron may acquire, by tempering, a coercive force sufficiently great to allow it to be strongly and permanently magnetized. The gray iron is the best for this purpose. The pot-metal is too brittle, and the first quality of cast-iron gives but moderate results.

The permanence of the magnetism depends on the temper. A bar tempered at a dull red heat may be powerfully magnetized, but loses its force in twenty-four hours. If the tempering is done at a bright red heat, the bars not only will take a powerful magnetism, but keep it indefinitely. Experiment has shown that the following is the best mode of tempering large bars:—They are to be heated to redness in a wind furnace, then withdrawn, one by one; the two faces of the bar are sprinkled for three-fourths of their length with yellow prussiate of potassa, and immediately plunged into a great mass of cold water, stirring it about violently. A little more thickness should be given to bars of cast-iron than to steel.—*Journal of the Franklin Institute.*

GALVANIC OPERATIONS AT THE ROYAL OBSERVATORY.

AT the Anniversary Meeting of the Royal Astronomical Society, (Feb. 10), it was reported that the organization of the Galvanic Operations connected with the ordinary business of the Observatory was gradually becoming more complete. By means of the galvanic motor-clock and the system of wires connecting the Observatory with the South Eastern Railroad Company's Station at London Bridge, hourly signals, giving accurately Greenwich mean solar time, are transmitted to the offices of the Electric Telegraph Company at Lothbury and the Strand in London, and to Tunbridge, Deal, and Dover, several times in the day. Signal-balls are dropped at the Strand and at Liverpool simultaneously with the drop of the Greenwich ball at 1 o'clock. In addition, by means of an ingenious contrivance at Lothbury, time-signals are sent at 10 o'clock A.M. and at 1 o'clock P.M. each day, primarily from Greenwich, to various stations on the line of the Electric Telegraph Company. Preparations were also making for the erection of a ball at the port of Deal, which it was also intended to drop simultaneously with the drop of the ball at Greenwich, by means of the wires on the line of the South-Eastern Railway. The various difficulties which occurred from time to time in the mechanism of the barrel or smooth motion clock, used for giving motion to the cylinder on which will ultimately be recorded the transits made with the transit-circle and altasimuth, according to the American method of self-registration, have been overcome. It now carries the cylinders put into connexion with it with perfect regularity, its rate having all desirable steadiness. The Astronomer Royal was in negotiation with Mr. De La Rue for a supply of paper best adapted for receiving the record of the transits,

and that gentleman, with his accustomed zeal for the interests of science, has given his attention to the subject. In the mean time, satisfactory trials have been made of the general efficacy of the apparatus by trial of an ordinary sheet of paper applied to the cylinders, on which, by a pricker acted on at every beat of the transit-clock by the electro-magnets attached to the frame, marks were made with perfect regularity and with adequate force during several revolutions of the barrel. From the first instant of the laying of the wires connecting the Greenwich Observatory with the stations of the South-Eastern Railway Company and the Electric Telegraph Company, it was evident that one of the earliest and most useful applications of them would be the determination of the longitudes of several of the principal observatories in the British Isles and on the Continent, which lie near the lines of the wires. During the last year, the earliest possible opportunities have been taken for settling definitively, by the admirable facilities thus afforded, the longitudes of Cambridge, Edinburgh, and Brussels, with complete success, as far as regards the galvanic communications and the observations of the signals at all the observatories, and with only one instance of defective determination of the local time at one of the observatories. The method was first tried successfully in May, 1853, for determining definitively the longitude of the Cambridge Observatory; the requisite preliminaries for the accurate observation of the signals and the accurate determination of local time at each station being previously arranged between the Astronomer Royal and Professor Challis; and the requisite arrangements for insuring a complete circuit between Greenwich and the Lothbury Station, and from thence to the Cambridge Railway Station, being made at the instance of the Astronomer Royal by Mr. C. V. Walker, Engineer and Superintendent of Telegraphs of the South-Eastern Railway, and by Mr. Edwin Clark, Engineer of the Electric Telegraph Company, respectively.—*Athenæum*, No. 1380.

DETERMINATION OF LONGITUDE BY GALVANIC SIGNALS.

THIS method, employed first in America, was introduced into England by the Astronomer Royal, and has been applied to the determination in succession of the differences of longitude between the Greenwich Observatory and the observatories of Cambridge, Edinburgh, Brussels, and Paris. In the first and last instances, results have been published which prove the perfect success and accuracy of the method. Mr. Airy, on recently announcing in the public papers the completion of the operation between the Greenwich and Paris observatories, justly remarks that such an experiment could not have been made without the assistance afforded by commercial enterprise, and that commercial enterprise is in turn honoured by the aid thus rendered to science. In the summer of 1853, Professor Encke, following the example set in England, determined successfully by Galvanic Signals the difference of longitude between Berlin and Frankfort-on-the-Maine. Galvanism has also been applied to astronomical purposes in other ways. The method of observing

transits by the intervention of a galvanic circuit (just put in practice in America), in which only sight and touch are employed, and counting is not required, is now in operation at the Greenwich Observatory. It is found to be attended with more labour than the old method; but as it is free from errors to which the other method is liable, it lays claim to general acceptance. At Greenwich, also, the galvanic circuit is most usefully employed in maintaining the movements of distant sympathetic clocks, and in dropping time signal balls. A ball is dropped every day at Deal by a galvanic current from the Royal Observatory. Some anxiety was felt by astonomers respecting the continuation of that most indispensable publication the *Astronomische Nachrichten*, after the decease of the editor, Mr. Petersen, in February, 1854. This has been dispelled by a recent announcement that the King of Denmark has resolved to maintain the Altona Observatory in connexion with that of the editorship of that work. The *Astronomical Journal*, an American publication of the same kind, undertaken by a young astronomer and mathematician, Mr. Gould, for the especial information of his countrymen, has reached the end of Volume III., and will, it is hoped, be continued. Generally, it may be said of astronomy, at the present time, that it is prosecuted zealously and extensively, active observations being now more numerous than ever, and that the interests of the science are promoted as well by private enterprise as by the aid of Governments.—*Professor Challis to the British Association.*

IGNITION OF GUNPOWDER BY THE VOLTAIC BATTERY.

CAPTAIN WARD, R.E., having been requested by Sir John Burgoyne, Inspector-General of Fortifications, to carry out some experiments for determining the best form of Voltaic Battery for military purposes, he made himself fully acquainted with the labours of Ohm, Wheatstone, and others; and, whilst verifying many of their theoretical researches, made them the bases for his own inquiries. After a most careful comparison of several batteries, he adopted a Grove's Battery,—the solid elements being zinc and platinum, and the liquid nitric acid and dilute sulphuric acid; and he finally ascertained that plates, only 2 inches square, were, perhaps, the most satisfactory as regards work and cost. These he arranges in small elementary batteries of six pairs, which, with the containing box, occupy a space of only 7 inches long, 4 inches wide, and 4 inches deep, so that eight or nine of these elementary batteries, capable of igniting gunpowder at the greatest distances likely to be required for military purposes, would be arranged in a space of 1′ 2″ by 1′ 4″ or 1′ 9″ by 1′ 4″. In carrying out his experiments, and especially in determining the relative value of each form of battery and the effect of any modification of the battery or of the conducting wires in respect to the caloric effect, Capt. Ward found that the deflexion of the needle of the ordinary galvanometers was so great as to render it unfit for the estimation of differences in the electro-metric force in such powerful currents; and he, therefore, constructed a very simple instrument, by which he is enabled to interpose one, two, or more pieces of thin pla-

tinum wire in the circuit; and, using this instrument, in conjunction with Prof. Wheatstone's Rheostat, to determine the relative force of any battery, as well as the resistance of the platinum wire itself, by the calorific effect exhibited on the fusion of the platinum wire.—These researches are now preparing for publication in the Professional Papers of the Corps of Engineers; but Lieut.-Col. Portlock has already made known to the British Association these first labours of a most talented young officer, who has been appointed to the responsible post of Master of the Australian Mint. He was first recommended by Major-Gen. Lewis as a person highly fitted to conduct the electrical experiments, and commenced them under his direction at Portsmouth; but he soon passed far beyond the simple experiments then projected, and has rendered his researches not only valuable as a scientific work, but important as an example of assiduous study and careful experiment to his brother officers.

LOSS OF THE TAYLEUR, AND CHANGES IN THE ACTION OF COMPASSES IN IRON SHIPS.

THE Rev. Dr. Scoresby has read to the British Association an inquiry, the leading object of which was to develope the principles on which the peculiar magnetic condition of iron ships was distributed, and to show the principles and circumstances under which changes must necessarily take place. The melancholy case of the *Tayleur*, afforded an example of the most impressive kind to connect with the general bearing of this most important subject. We have not space for the details of this paper, (to be found in the *Athenæum*, No. 1406.)

We pass to the general result of Dr. Scoresby's experiments, which went to the establishing of the fact, that besides the two denominations of magnetism ordinarily received, that of simple terrestrial induction and that of permanent independent magnetism, there was another denomination corresponding with neither; not being absolutely controllable, like the former, by terrestrial influences, nor capable, like the latter, of resisting all kinds and modes of mechanical violence. To this third denomination he gave the name of Retentive Magnetism. Dr. Scoresby then exhibited experiments with three sets of plates, two of iron and one of steel, for the illustrating of these several qualities of magnetism:—1. That of simple terrestrial induction by iron plates free from polarity, which became magnetic or changed their magnetism according to the position in which they were held. 2. Retentive magnetism, as illustrated by similar plates, which had been previously magnetized by bending and blows,—such magnetism appearing as if permanent when the plates were moved about, without being vibrated or bent. And, 3rdly. Permanent magnetism, as illustrated by an elastic steel plate, which, however violently it was bent or struck or vibrated, or in whatever position, still preserved its magnetism unaltered. Now this retentive magnetism was the quality which had been prevalently considered as permanent; which, he was prepared to show, both by experiments on iron and facts of experience, was by no means a fixed quality. On the contrary, the long continued vibration of a ship under steam, and much more so the straining of the ship in a heavy sea, under the circumstance when the terrestrial induction might be acting in a very different direction from the original axial polarities of the ship, would be sufficient to change the direction of the magnetism originally developed in the course of her construction. Hence, much would depend, in respect of the mechanical action of the sea, on the position in which the ship had been built. In the case of the *Tayleur*, when he first heard of the catastrophe, and had read the evidence, he had stated to some friends at Torquay, that he would venture to predict that she had been built *with her head* northward. He had found, on inquiry, she had

been built with her head nearly north-east. Here, then, were the precise circumstances for expecting a change in the ship's magnetic distribution. Having been built with her head to the north-east, she had a certain magnetic distribution accordingly, and when she began to strain, with her head to the south-west, that distribution was necessarily changed, and the first effect of it had been to produce a great difference in the two compasses adjusted by fixed magnets. If the captain had been aware of the changes which might, and most probably would, take place, when the ship began to strain in a different position from that in which she had been built; if he had known that the compasses, having so large an original deviation as 60°, might vary as much as two, or three, or even four points, he would have known, of course, that he must place no reliance upon them. It did not follow, however, that compasses were of no use, because, under certain circumstances, they were liable to change. They should be, and were, of great use for all that. But what he wished to impress upon them was, that by attempting to adjust a changeable influence by a permanent influence, they were liable to produce an aggravation of error. It was most important, therefore, for safety in navigating these vessels, that captains should be made aware of the liability of the compasses to change and so to mislead them; that they should know the circumstances under which, in accordance with natural laws regulating and applying the earth's inductive action, changes were most likely to occur; that they should be always watchful of opportunities for determining the true magnetic direction with reference to their compasses, by observations of the sun and stars; and that by providing a place for a standard compass aloft, (on the plan he, Dr. Scoresby, had suggested and adopted in 1822,) as far from the deviating influence of the body of the ship as possible, they might have guidance sufficient, with some small allowances, for steering a correct magnetic course. And with the precautions and means such as might thus be applied, he, Dr. Scoresby, did not doubt but that the difficulties, in respect of compass guidance, in the navigation of iron ships, might be mainly and practically overcome. The general experimental results and the principles sought to be elucidated, were illustrated by a variety of references to actual cases of compass changes in iron ships.

CORRECTION OF THE COMPASS IN IRON SHIPS.

CAPTAIN FITZ-ROY, in the *Athenæum*, No. 1411, observes:—All seamen, and the majority of the public, are aware that the magnetic needle is considerably affected by the iron of a ship,—but they do not so generally realise in their minds the fact that a common steering compass may be some points in error, owing to the vicinity of iron, and that if such error be unheeded, the ship with perhaps a thousand souls on board may be steering a fatal course (as in the case of the *Birkenhead*), while all on board believe there is no cause for unusual watchfulness. To those who have not attended to the subject of magnetism it may be pardonable to observe, that the compass-needle is not only drawn towards the poles by the magnetic influence which affects it under any circumstances, but that the attraction of the iron in the ship is an active agent, drawing the needle more or less from the position it would have if free from any local influence besides that of ordinary terrestrial magnetism. This special attraction, now generally called deviation, is usually greatest when the ship's head is eastward or towards the west, and least when nearly in the magnetic meridian. Moreover, it varies as the ship heels, or careens over, because of the varying position and influence of the iron and the varying relative position of the compass needle which remains horizontal.

Admirable illustrations of these effects have been given frequently

by Sir W. Snow Harris, Capt. W. Walker, and Dr. Scoresby, besides other well known authorities.

As some, many indeed, of the iron ships have inconveniently large deviation errors of the compass, it is indispensable to guard against them in some special manner. Her Majesty's ships are "swung"—that is, they are turned round—so that the bearing of an object may be taken with the ship's head successively on the principal points of the compass, and a table of errors formed by which the courses afterwards steered are to be corrected until the ship is swung again or has changed her locality considerably. This method has been followed for many years—for more than a quarter of a century—sanctioned by those who were supposed by the Lords of the Admiralty to be the best judges of the subject, especially Col. Sabine. So decided has been this view of the question, that the Board of Trade is now issuing recommendations to merchant ships to avoid the other plan, which shall now be described. This other method is a mechanical correction of the errors caused by the magnetic influence of iron in the ship herself by means of magnets fixed near the compass. The high authority of the Astronomer Royal is given in favour of this manner of correction by magnets,—and is as decidedly expressed against the custom of Her Majesty's ships. There is no mistake on this subject. Both views are before the public in print. Both cannot be right. Which are practical seamen to adopt? The sooner the question is settled the better for all whose business is on the great waters, and for the improvement of navigation.

Respecting the process of "swinging" a ship, it may be observed that so much time and minuteness of detail as are now usually given are not necessary. Observations on a few well-chosen points of the compass are sufficient. From them a table or a diagram may be constructed. But the best time for swinging or turning a ship is when she is out of harbour with everything on board. A distant object may then be used as a mark, or transit bearings of known positions observed. While at sea the heavenly bodies, when not obscured, afford means of checking the compasses continually, especially (in this hemisphere) the pole star.

When a distant terrestrial object is visible, the deviation of the compass on any or every point may be quickly obtained by the difference between bearings with the ship in the direction which causes no deviation, and a bearing or bearings with the vessel placed otherwise. This is a simple method though efficient. Alteration in the ship's local attraction or magnetism may take place from time to time; but unless iron be moved near the compass, the position in which the ship herself acts on the needle, in the same direction as the general influence of terrestrial magnetism, remains nearly unchanged. A sailing vessel may often try one or two bearings in this manner without much inconvenience. A steamer may do so easily, as well as frequently.

It should never be thought safe to trust implicitly, or for a length *of time, to any condition* of magnetism. So subtle and variable an *influence—subject to* sudden or gradual change—whether from jar-

ring blows, from vibration or from electrical action—ought always to be suspected and therefore watched vigilantly. The Astronomer Royal expresses his opinion, that the sea does not cause such sudden blows as Dr. Scoresby refers to; but he will not be supported by nautical men in such a view. They who have felt the sudden shocks of heavy waves cannot be mistaken on that point.

Correcting Magnets—such as are recommended by Prof. Airy—are found to be very useful in ships employed within moderate limits of latitude, as in the North Atlantic and the Mediterranean; but they are always liable to uncertain change. A flash of lightning may destroy or reverse their polarity ; yet the injury may be undiscovered till too late. In using magnets as correctors, it should be borne in mind that, if the ship's deviation is great, very powerful magnets must be employed to counteract it, or those used, if of inferior power, must be placed very near the compass; and then, when the ship heels much, for some time consecutively, the effect on the needle may be very much altered by being brought nearer to the magnet. The Astronomer Royal says, that "a quarter of an inch in the height of the compass may very greatly disturb the neutralizing influence of the magnets." When thus affected, the compass may indicate a bearing or course considerably different from that which it would show were the ship upright. Prof. Airy approves highly of Dr. Scoresby's experiments; yet their tendency, as stated to a large audience at Liverpool, was certainly to discredit the employment of the Correcting Magnets. In a surveying vessel, employed a quarter of a century ago, a neutral point was the station of the Principal or Standard Compass, at which point there was little or no effect of deviation visible, because there were balanced local attractions abaft, before and on each side of the compass. The advantages of such a neutral point were suggested by the plan of Prof. Barlow, namely, the correcting plate used by the lamented Captains Foster and Basil Hall. In all parts of a prolonged voyage round the world, the neutrality of that selected point remained unaltered, and its utility was undisputed.

See also papers upon this important investigation by the Rev. Dr. Scoresby, in the *Athenæum*, Nos. 1415 and 1416.

VARIATION IN THE RATES OF CHRONOMETERS.

MR. J. HARTNUP has read to the British Association,* a paper detailing the means by which he subjects, at Liverpool Observatory,

* The little aid afforded to science by the British Government, notwithstanding the affectation of such patronage in high places, has long been a fair subject of European reproach: and was thus adverted to by the Earl of Harrowby, the President of the late meeting of the British Association:—"Meanwhile what was the State doing? That State which, with its limited population and territory, depends not upon the number of its people, but upon the individual value of each man,—not upon the number of its acres, but upon their skilful cultivation,—not even upon the resources of its surface, however well developed, but upon the mines which lurk beneath it,—not even upon its mines, but upon all the various and varying manufactures, which these mines give extraordinary facilities for carrying on; not even on these manufactures, but on the extended commerce and navigation, which are necessary to provide the materials to draw them forth

the Chronometers entrusted to his care to different temperatures; and by such means, he states, that he is able to furnish the masters who take them to sea with the rates which those chronometers will take up in the various latitudes through which the ship which carries them may have to pass. Capt. Fitzroy, R.N., wished to warn all captains of ships against the risk of taking their chronometers on shore, and then on board again, after having been rated. Rating them under proper supervision on board by the dropping of time-balls, he considered much to be preferred. He also gave a warning that captains should not, particularly after being long at sea, trust too implicitly to the performance of single chronometers without properly checking that performance from time to time; as he knew that rates however accurately determined on shore, varied on long voyages.—For Mr. Hartnup's paper, see the *Athenæum*, No. 1407.

ROYAL GREENWICH OBSERVATORY.

THE Annual Visitation of the Royal Observatory took place on Saturday, June 3, when the Board of Visitors inspected this national establishment. The Astronomer Royal, in his Report, stated that he trusted to be able to announce, at a very early date, the conclusion of the very important operation of determining the longitude difference between the observatories of Greenwich and Paris.

In his last Report, Mr. Airy alluded to the erection of a time signal ball at Deal, to be dropped every day by a galvanic current from the Royal Observatory. The ball has now been erected by Messrs. Maudslay & Field, and the galvanic connexion with the Observatory, through the telegraph wires of the South-Eastern Railway, is perfect. The automatic changes of wire communications are so arranged that, when the ball at Deal has dropped to its lowest point, it sends a signal to Greenwich to acquaint Mr. Airy, not with the time of the beginning of its fall (which cannot be in error), but with the fact that it really has fallen. The ball has several times been dropped experimentally with perfect success, and some small official and subsidiary arrangements alone are wanting for bringing it into constant use.

from the remotest corners of the earth, and to send them back with speed, safety, and economy, in another form and combination, often to the very spots from which they were derived;—in a word, dependent for the full development of its agriculture, its mining industry, its manufactures and its commerce, upon the widest extension and the fullest cultivation of Chemistry, of Natural History, of Mineralogy, of Geology, of Astronomy, of Meteorology and Mechanics. What did the State do for these things? Why, absolutely nothing. There was for a time a Board of Longitude, which, instead of enlarging and improving, it abolished; a Board of Agriculture, which it dropped; a School of Naval Architecture, which, at the bidding of a narrow economy, and at the instance of practical men, it abolished when the fruits were ripening; a School of Naval Instruction, at Portsmouth, which it dropped. Here and there still survives a grant from the bounty of an individual monarch, grudgingly adopted by the State,—of 10*l.* for a Professor of Natural Philosophy at Aberdeen, or 50 guineas for a similar Professor at St. Andrew's, or 150*l.* to one at Glasgow, or 30*l.* to one at Edinburgh, and, more recently, grants of 100*l.* a year each to four or five Professors in each of the old Universities of England. This is, as far as I can discover, all that the magnificent State of Britain did, until recently, for that Science on which her wealth,—and if her wealth, her power,—and if her power, her very existence,—is dependent."

No step has yet been taken for the galvanic determination of the longitude of the Oxford Observatory, but the necessary preparations within that building are now complete.

The normal clock, with its small adjusting apparatus, has been in constant use. It drops the Greenwich ball and the Strand ball; it sends daily signals along several railways, and it maintains in sympathetic movements various clocks by galvanic currents. Among other clocks thus moved, one is in the chronometer-room, one at the Observatory entrance gate, and one at the South-Eastern Railway offices, London-bridge.

The barrel apparatus for the American method of transits, has been practically brought into use, not, however, as Mr. Airy states, without having met with a succession of difficulties which happily have been overcome. Still Mr. Airy considers the apparatus troublesome, consuming much time in the galvanic preparations, and other details. But its high astronomical merits of general accuracy render the method very far superior to the former mode of observing by the eye and ear.

The beautiful system of registering magnetical and meteorological changes by means of photography, continues to be employed, and efforts have been made to multiply copies of the Photographic Registers. After many experiments, it was found that, by the agency of sunlight upon the back of an original photograph, whose face was pressed closely, by means of a glass plate, upon proper photographic paper below, there would be no difficulty in preparing negative and inverted secondaries, and, from them, positive tertiaries. Thus, beyond the trouble which the process involves, Mr. Airy anticipates that it will be easy to multiply copies to any extent which may be desired.

The changes among the Observatory instruments have been so trifling during the past year as not to require definite notice. A fire-proof room, for the preservation of valuable documents will shortly be constructed, a sum having been granted by the Admiralty for that purpose.

Under the head of "General Remarks," the Astronomer Royal thus concludes his Report:—

The past year has, on the whole, been felt as a laborious one. This has arisen from a cumulation of several perfectly distinct causes. The order of our printing has been disturbed, and this has produced great disarrangement of all our ordinary daily work. The establishment of our galvanic system, and its application to American transits, to public time-signals, and more especially to the longitude-determination, has caused to the establishment in general, and to myself in particular, a great consumption of time. The preparation of the Observatory Regulations, and of the description of the Transit-Circle, and the closing of the business of the Standard Commission, have required a great amount of writing which could be entrusted to no one but myself. I may confidently hope that in the next following years several of these causes will not be in action. Still I am impressed with the feeling that the strength of our establishment is now loaded to the utmost that it can bear. A brief review of the progress of the science of Astronomy and of the arts related to it will show that this must be expected. The number of known planets has been largely increased: and I cannot think that in *this* National Observatory the neglect of any one of the bodies of the Solar System *is permissible*. The American method of transits adds to our labours; but it

appears likely to contribute to accuracy, and it will give facilities for the record of the observations made at other Observatories, upon our registering-barrels; and if these advantages are established by experience, the method must be maintained. The public dissemination of accurate time brings some trouble; but it is a utilitarian application of the powers of the Observatory so important that it must be continued. The galvanic determination of difference of longitude brings with it a mass of work in negotiations, in preparations, and in calculations; but it produces results of such unimpeachable excellence, and of such value to astronomy and geodesy, that it must in anywise be preserved as part of our system. Time is consumed in experiments for the improvement of our photographic process, and in measures for the multiplication of copies; but these are worthy objects of attention, which it would be wrong to neglect. All these are additions to the labours of the Observatory as they existed a few years ago, unbalanced by any corresponding subtraction.—*Athenæum*, No. 1389.

PHOTOGRAPHS OF THE MOON AND OF THE SUN.

THERE has been read to the British Association, a paper "On Photographs of the Moon, and of the Sun," of which the following is an abstract:—

"It is well known that the early attempts of astronomers to obtain photographic representations of the moon were rewarded with no success. Signor Rondini had indeed obtained photographic images of the nebula and sword of Orion; and these are stated to have been of such singular beauty and precision, that each star, each filmy nebulous streak, faithfully depicted its own position. Dr. Robinson, of Armagh, was led, by the report of these experiments, to endeavour to procure a daguerreotype impression of the moon's surface. A portion of the disc, as he stated at the Meeting of the British Association at Cork, in 1843, was brought within the image of a powerful reflecting telescope, at which time the crater of Copernicus was in active operation, and giving out a most intense light. This brilliant image was thrown upon a daguerreotype plate which was placed in the focus of the reflector, and left exposed to its action for twenty minutes. Although a good impression of a building could be procured, upon plates similarly prepared, in a minute, yet this prolonged exposure to this light produced no impression. The experiment by Dr. Robinson was supposed to prove, in the first place, that lunar light will not act upon ioduret of silver, and in the next place, that it is not combined with that chemically active principle, which is termed by Hunt, Energia; and which exists in the rays of the remote stars which form the nebula of Orion's sword and Andromeda, and as I may state from experiments in Dr. Lee's Observatory and my own, in the rays of α Lyræ also. These conclusions, however, were too hastily arrived at, for it can now be proved that Dr. Robinson's failure arose not from the entire absence of chemical action in the moon's rays, but from his using a preparation of silver in which the equilibrium was not sufficiently unstable to be overcome by so weak a force.

More sensitive preparations have afforded other and satisfactory results. Mr. Whipple exhibited, in the United States' department of the Exhibition in 1851, a daguerreotype of the moon, which received the highest commendation, as being one of the most satisfactory attempts that had been made to realize, by a photographic process, the telescopic appearance of a heavenly body; and thus to commence a new era in astronomical representation. Two daguerreotypes of the moon, an original and a copy, illustrated this paper. The fainter picture, produced by the moon herself, in the focus of Bond's refractor, was taken in America. It possesses a very remarkable but latent sharpness, which, however, is so scarcely visible to the eye, that to ascribe to it this character may almost provoke a smile. The proof of its having such a property is furnished by the beautiful copy of it of the same size, which my friend, the Royal Astronomer for Edinburgh, obtained by throwing strong sunlight upon the moon's daguerreotype picture of herself, and obtaining a reverse solar impression of it in a common camera, the conjugate foci being equal. The tones of grey and yellow which mark the action of the moon, become, when handled by the sun, fine contrasts of black and white. The mountain chain round the portion of the Mare Imbrium, is finely given in the copy, though it almost requires a stretch of the mind's eye to discover some of the details in the original. The well-known ray of light from Menelaus passing through the centre of the Mare Serenitatis, is another point of

striking contrast in the two pictures, as well as the outline of the shadows in several of the craters. It is said that Lord Rosse was much interested with this happy experiment by Professor Piazzi Smyth, as it tended to solve a question which had often occurred to him respecting the probable beneficial use of penetrating sunlight under such circumstances; and in this point of view, it is well worthy of being recorded. Two Calotype examples of selenography form additional illustrations of this paper. The small moon fastened on a corner of the larger picture, was taken by Mr. Henry Pollock with a double combination of short focus, and in less than a second. The bright point of Tycho, though on so small a scale, is well marked on the top of this minute Calotype, and the seas, to which I have already referred, give their more sombre reflection at the bottom. This is chiefly of interest as showing the decided energy of a power which in former years was supposed to be absent.

The more important drawing is a large positive picture of the full moon, nearly nine inches in diameter, and therefore on a scale of 250 miles to the inch, of which the negative was taken, on the 6th of September, in the focus of the "Craig telescope," at Wandsworth, whose diameter is 24 inches and focal length 77 feet; and when I state that it is the first attempt, it will be received, notwithstanding certain imperfections of manipulation, which are not concealed by artificial tinting, as a step in the right direction. All the more important features of the moon's surface will be discovered by those who are familiar with their telescopic appearance, and the portion of the eastern hemisphere admits of interesting comparison with the sun's daguerreotype copy already described. We find in both, and with almost equal distinctness, the Mare Crisium with the bright surrounding country which separates it from the Mare Fœcunditatis and Mare Tranquillitatis to the south and west,—the Crater Menelaus with the ray already spoken of,—the semi-circular ridge round the Mare Imbrium, and the unreflective crater, Plato, at its north-west extremity. On the western side, we have the bright Aristarchus, Kepler, Copernicus, and Tycho, with the streams of molten lava extending over the southern hemisphere; but owing to the phase of full moon, the craters and mountains are not relieved by shadows. The time of exposure of the collodion negative was thirty-five seconds; but it is evident that Tycho and the brighter portions are overworked. In the absence also of an equatorial mounting, perfect steadiness could not in the first instance be secured. Mr. Gravatt applied a micrometer screw to the eye end of the telescope, and turned it with a winch handle, and when the moon was on the meridian this was almost tantamount to an equatorial motion for the space of thirty-five seconds. A fine wire stretched across an aperture in a slip of wood was placed close behind a negative when in the focus of the telescope, and Mr. Gravatt found that by humming a tune he could turn the handle of the micrometer so steadily as to keep Aristarchus continually bisected. Mr. Prout, who prepared the collodion surface, unfortunately counted the seconds too loudly for "the man at the wheel," and hence arose a little cause of unsteadiness, which was afterwards prevented by my attending to the time of exposure instead of Mr. Prout. Collodion pictures of the moon, as well defined as her image on the ground glass, and taken through all her phases, would leave scarcely anything to be desired, in consequence of the magnifying power of the object-glass itself; and future experiments will be directed by Mr. Craig into this channel. On the night of the 11th of September, we renewed our attempt when the moon was in a more picturesque position; but an undetected source of error, and the increasing density of the fog, when the moon was on the meridian, prevented us from procuring a successful negative. Moreover, the true photogenic focus has not yet been obtained by means of sulphate of quinine. I may state, however, that the division in Saturn's ring, the slate-coloured ring, and the inner satellites, were well brought out with my solid eye-piece, under a power of 300; and α and ϵ Lyræ, with their minute companions, were also well exhibited. In fact, the present superiority of the telescope, though confessedly admitting of improvement in figure, consists in its command over the faintest points of light. That so large an object-glass, worked at a mechanical disadvantage by hand, and not machine polished, should do so much in its first offer to the stars, is far from discreditable to those who calculated and ground the curves; and the errors which are now known and estimated, will be corrected by re-working the surfaces on the plan adopted by Lord Rosse and Mr. Lassell. On the 12th, the morning following, I endeavoured, with Mr. Gravatt at his proper post, to take the sun on the meridian, and on the same scale as the moon; and I succeeded by an instantaneous operation in exhibiting

in the negative, the peculiar mottled character of the surface which is usually brought out by high magnifying power. Dr. Diamond, who printed the positive of the moon, found the sun picture, however, rather overdone for transferring. It will be necessary, therefore, either to use collodion and nitrate of silver simply, without any or but little sensitive solution, or else to pass the sun's rays through some coloured glass, which will partially retard their energy. A series of pictures of the spots on the sun, as well as of the general surface, may then be successfully obtained; and hence it is not too much to anticipate some accession to our knowledge of the physical character of both our great luminaries by means of this gigantic telescope, which Dr. Diamond enables me to exhibit photographically to the Section.—*Athenæum*, No. 1407.

There have also been presented to the Association communications from Professors Challis and Piazzi Smyth, accompanied by three large drawings of the Mare Crisium, after sunrise on that part of the lunar surface, at mid-day on the same, and before sunset, executed by Professor Smyth; and by Diagrams of Plato and the regions around it, by Professor Challis. In commenting on the results of the labours of the Committee during the past year, Professor Phillips drew attention to the methods employed by Professor Smyth and Professor Challis, which combined instrumental measures, eye sketches, and finished designs; and presented the various aspects of the lunar surface, depending on the angle of illumination, which had been expressly indicated by the Committee. He remarked on the continually growing exactness with which the telescope was applied to the delineation of the lunar scenery, which, to inferior instruments appearing smooth and even, revealed itself to more powerful scrutiny as altogether uneven, mostly rugged land, deeply cut by chasms, and soaring into angular pinnacles. The so-called seas, under this scrutiny, appear destitute of water; and their surface, under low angles of incident light, becomes roughened with little points and minute craters, or undulated by long winding ridges of very small elevation, comparable to the gravel ridges of Ireland and Scandinavia. On the question thus and in other ways raised for discussion, whether the moon, now devoid of water on the face she presents to us, contains traces of ancient watery movement, Professor Phillips called attention to the numerous straight rifts and winding "Rillen," as the Germans call them, which, to clear telescopes only, reveal themselves in many tracts of the lunar land. And turning to Gassendi, the mountain which, in connexion with Mare Humorum, had been allotted to himself for his survey, he described its long encircling wall, broken through towards Mare Humorum, duplicate in one part, crossed by three deep narrow clefts in another, and partly interrupted by a great oval crateriform appendage, which is broken down or deficient on the side against the great crater of Gassendi. Here, concentrating to, or diverging from, the smaller crateriform appendage, are seen, but only with good instruments, many branching ridges and hollows, whose stems are towards the small crater, and whose extremities reach towards the mountains in the middle of Gassendi. If these are branching tracts of volcanic matter poured out from the smaller crater, their *slope will be from it; if they be due to alluvial action, their slope will be towards it;* and this is a test which perhaps can be accu-

rately applied in this situation, by carefully delineating the shadows which fall in morning and evening from the lofty walls of the crater. The Report contained also references to the progress made by the Committee and the Liverpool Photographic Society in obtaining light-pictures of the moon.

Mr. Nasmyth, on the question of ancient traces of water in the moon, maintained the negative, and expressed his conviction that all the appearances sometimes relied on for the affirmative were explicable by consideration of the peculiar character of the old volcanic operations on the moon.

METEOROLOGICAL PHOTOGRAPHS.

SOME beautiful Photographic Drawings of Snow and Crystals, seen in January, 1854, and drawn by Mrs. Glaisher, have been presented to the British Association, and explained by Dr. Lee. This collection, including between twenty and thirty varieties, was the result of a morning's observation, on January the 1st, 1854, when snow fell in slight and gently-drifting showers.

Dr. Lee also exhibited some beautifully accurate photographs, by Mrs. Glaisher, of the standard barometers, thermometers, wet and dry bulb, and other meteorological instruments, with their stands and arrangements, as used and recommended by the British Meteorological Society. The standard barometers are those made by Mr. Barrow, of Oxendon-street, London; and the several thermometers and their stands by Messrs. Negretti and Zambra, as is also the rain-gauge constructed by Mr. Glaisher, F.R.S.

NEW INSTRUMENTS.

PROFESSOR BERNARD has exhibited to the British Association his New Barometer, his Universal Photometer, and New Refractometer. The latter instrument is founded on the principle of passing a ray through a medium bounded by two parallel surfaces, and may be called the Refractometer of separation (*réfractometère de transport*). When a ray passes through such surfaces, if it be incident perpendicularly, it emerges in the same course. If it be incident obliquely, its emergent course is parallel to that of its incidence. Neuter relations which connect the perpendicular distance between the incident and emergent rays—the angle of incidence—the thickness of the medium or distance between the surface bounding it—the index of refraction is shown—the first two can beobserved, the third measured, and then the fourth, which is what we seek, is a matter of simple calculation. Dr. Whewell expressed the pleasure he experienced at seeing these very beautiful instruments; and was particularly struck with the clear proof arrived at by Professor Bernard, that the light of the several parts of the solar spectrum was simple, and not compounded light; and that thus the view, which had been some years since propounded, and which was still entertained by some, that the spectrum obtained by the prism was composed of several superimposed spectra, is proved to be unfounded, and must be abandoned.

NEW PHOTOMETER.

MR. BABINET has described to the British Association a Photometer, consisting of a tube, at one end of which was a Nichol's Prism, through which the light to be valued is admitted, the radient or source of the light being placed at a measured distance. As it passes along the tube, the light encounters a bundle of glass plates, through which, as it passes, it is polarized by refraction. It then passes on, and is received at the eye-pieces; another tube, furnished also at its extremity with a Nichol's prism, enters the side of the first tube at such a place and at such an angle as that light admitted from a standard source at a fixed distance is reflected to the eye-piece by the same bundle of parallel glass plates, through which the former light is refracted. By turning the Nichol's prisms, exact complementary colours can be had from each source; and where the images of oblong slits, through which the light passes, are made to cross at the eye-piece, the crossed part will be free from either colour when the light to be tried is at exactly the distance which gives the same intensity to the light which enters the instrument as that which comes from the standard. A comparison of the squares of these distances gives the intensity of the light to be valued, in the usual and well-known method.

STEREOSCOPIC PHENOMENA.

M. DOVE has drawn the attention of the British Association to this subject, chiefly in consequence of Sir David Brewster having denied at the Belfast Meeting the soundness of the explanation which the author had given of the cause of the appearance of those bodies which exhibited the metallic lustre. This, he considered, to arise from the superficial layers of particles being highly, though still imperfectly, transparent, and permitting the inferior layers to be seen through them. This effect we see produced when many watch-glasses are laid in a heap, or when a plate of transparent mica or talc being heated red hot is thus separated into multitudes of thin layers, each of which, of inconceivable thinness, is found to be highly transparent, while the entire plate assumes the lustre of a plate of silver. This explanation receives a very striking confirmation from the Stereoscopic Phenomena which he now drew attention to. He then presented and described a very simple and portable modification of the stereoscope, consisting of two lenticular prisms mounted in a frame like a double eye-glass. Upon examining with this two diagrams drawn one for the right, the other for the left eye, with lines suited to give the idea, when viewed together, of a pyramid, cube, cone, or other mathematical solid, but the lines on one drawn on a white ground, the other on a dark or coloured ground, on viewing them together the solid appeared with the metallic lustre. The author termed it "Glance." This, he conceived, demonstrated his original idea to be correct.

IMPRESSIONS ON THE RETINA.

THE Rev. Dr. Scoresby, in a paper read to the British Association,

"On Pictorial and Photochromatic Impressions on the Retina of the Human Eye," has explained with much minuteness, accuracy of detail, and skill in the arrangement, the varying phenomena which presented themselves to him after gazing intently for some time at bright luminous or strongly illuminated objects—as the sun, the moon, a red, or orange, or yellow wafer—on a strongly-contrasted ground, or a dark object seen in a bright field. Upon removing the eyes from the object, the author explained the early appearance of the picture or image which had been thus impressed on the retina, or, as he expressed it, "photographed upon the retina," with the series of photochromatic changes which this picture underwent while it still retained its general form and most strongly-marked features. Also, how these pictures, when they had almost faded away, could at pleasure, and for a considerable time, be renewed by rapidly opening and shutting the eyes. The entire series of phenomena would be more than our space would permit us to describe in detail, as given by the author; but they merit some permanent record of them being published. Indeed, from our own experience, we can affirm that they vary in their general character in different individuals; and even the same individual finds them different, especially as to the succeeding series of photochromatic changes at different periods of life. Some very surprising examples have come within our own experience.—*Athenæum*, No. 1408.

THE TELESCOPE.

MR. C. VARLEY has read to the British Association a paper "On Natural Occurrences that impair the Vision of good Telescopes," by Mr. C. Varley. 1. Everything moving on the earth causes vibrations; the result is tremors, too fine to be known till high magnifying proved their existence, and the very best braced stands would convey them to the telescope. He stated this fact:—On placing his ear close to the ground on Bromley Common he heard, first, a heavy waggon about a mile off; second, a one-horse cart; third, a stage coach in Bromley two miles off: their differing distances and approach were indicated. These he afterwards met in reverse order from their differing speed. This proved tremors which would affect high powers, and from the number of greater causes than these he inferred the earth's surface to be rarely or never free from such. He showed two means of insulation so as to avoid them. First, cushions of wool or thick india rubber under the three feet. Second, supporting the telescope by pulley-block (which has been done for Newtonians with success), such blocks and ropes being quite incapable of receiving or transmitting vibrations or tremors, and were therefore the most perfect insulators. The high northern support of polar axes received tremors from the earth and enlarged them upwards, but heavy top bars leaning against them might be made real discords or dampers. 2. The ever-varying density of the air from vapour, temperature, pressure, and currents. 3. Sounds of all sorts, percussions, winds, and the sea roaring, causing continual vibrations even to the telescope of dense and rare alternations; all which disturbed the passage of

light and made the stars twinkle into a much larger diameter than they were known to possess, and this twinkling affected all features equally small, and would ultimately limit the definition of high powers, if we did not remove as much as possible above all fogs and such like interferences, and also sounds. From his own observations 600 feet high began rapidly to escape from them, and to afford much clearer vision through the atmosphere.—*Athenæum*, No. 1408.

NEW PROCESS FOR THE MANUFACTURE OF GLASS FOR OPTICAL PURPOSES.

In the present state of this Manufacture, the mass of glass having been brought to a state of fusion in the crucible or pot, it is simply stirred to render the material homogeneous, and to free it from the air which it contains. This double result is, however, very rarely attained, and the operations of stirring, as it is now performed, gives rise to the formation of numerous striæ, which render the larger part of the glass unfit for the making of the lenses. Hence arises the difficulty of obtaining object glasses of large dimensions. M. de Peyronny believes he has found the solution of this difficulty: that is, the means of manufacturing glass free from defects, by communicating to the pot which contains the material in fusion a rather rapid rotary motion about a central vertical axis; the centrifugal force would have the effect, according to him, of collecting all the air-bubbles towards the centre of the vitreous mass; while the striæ produced by the stirring would in great part disappear, and those which would remain would be circular and but slightly injurious, if care be taken to make the axis of the primitive mass the axis of the lens.—*Comptes Rendus.*

THE MODERN COMPOUND MICROSCOPE.

Mr. Charles Brooke, M.A., F.R.S., has read to the Royal Institution a paper "On the Construction and Uses of the Modern Compound Microscope." He said, so little is generally known of the management of compound microscopes that many persons who possess really good instruments are unable to use them properly; it was therefore very desirable that the principles of their construction should be understood. To commence *ab initio*, Mr. Brooke explained the principles of the reflection and refraction of the rays of light, which he illustrated by moveable diagrams; and he also illustrated the mode by which the refraction of the rays of light by a convex lens causes objects to appear magnified. In the construction of microscopes, great difficulty is experienced in overcoming what is termed the spherical aberrations of the rays of light, and the production of the prismatic colours caused by the dispersion of the rays. The colouring of the images is prevented by the achromatic lens; and to overcome the difficulty of spherical aberration, the object-glass is so constructed as to neutralize the positive and negative rays of which spherical aberration consists. The angle of aperture of a lens was explained by Mr. Brooke at some length; and he showed the peculiar advantages of having a large angle of aperture as dia-

tinguished from a mere increase of light. There were on the table two microscopes of the same construction, having the same object in the field of view, the only difference in the two instruments being that in one the angle of aperture was greater. This difference was, however, sufficient to make the object appear much more distinct in one instrument than in the other. In testing the quality of microscopes, it is usual to employ test objects, which from the delicacy of their structure are difficult to be distinguished, excepting by good instruments well adjusted. Mr. Brooke explained the nature of a test object of this kind, which he had under view. It consisted of a very minute and transparent silicious shell, the internal structure of which was discernible only by difference of thickness, and the different shades of light were not distinguishable excepting by instruments having object glasses of large angles of aperture. The illumination of the object is an important consideration in the use of a microscope, and this point, Mr. Brooke said, is not sufficiently attended to. All the rays of light ought to be conveyed to a focus on the object, and thence diverge from it in all directions. Nothing forms a better condenser of light than a white cloud opposite the sun; and the object of the microscope-maker, in the arrangements for illuminating the objects, ought to be to imitate this natural reflector. A white disc, composed of plaster of Paris, is generally employed for that purpose, from which disc the rays are reflected on to the object. Mr. Brooke said that the method frequently adopted, of using a mirror to reflect the rays upwards through the object, is very bad, since it tends to confuse the vision and prevent a good definition, by producing a glare of light, which ought to be particularly avoided. As an exemplification of the bad effects of a glare of light, Mr. Brooke exhibited a screen, consisting half of dark gauze and half of white gauze; through the former, or darker portion, objects were distinctly visible, but the glare of the white gauze prevented anything from being seen through it. On the lecture-table there was a magnificent collection of microscopes by the best makers; but Mr. Brooke said that, though Ross and Powell were highly celebrated, it was impossible to give preference to any one among the many excellent makers of such instruments.—*Morning Chronicle.*

Mr. Brooke has also communicated to the British Association, "An easy Method of making Thin Glass Cells for mounting Microscopic Objects in Fluid." The durability of thin glass cells, compared with cells consisting of a ring of cement or varnish laid on the slide by a brush, is well known to microscopists; but they have been hitherto somewhat difficult of construction, and therefore expensive. The proposed mode of making them consists in clamping the piece of thin glass between two pieces of gun-metal, having each a cylindrical hole. The pieces are clamped by two screws, the holes being kept concentric by two steadying-pins. One of the opposed surfaces is ground very flat, and the other has a narrow raised rim, about 0·1 inch wide, covered with very thin leather surrounding the whole, to insure a firm and uniform pressure round

the intended aperture. After scratching round both sides of the glass revealed by the holes with a writing diamond, the circular piece may be pushed out without any risk of cracking the remainder of the glass.

Mr. W. S. Gillett, M.A., has communicated to the Royal Society a paper, "On a new and more correct method of determining the Angle of Aperture of Microscopic Object-glasses." The very large apertures of the more recent microscopic object-glasses drew the author's attention some time since to the importance of testing the accuracy of the method employed to determine this amount. With this object in view, he began with the consideration that the central pencil was alone to be regarded, and that the marginal rays of this were the true limits of the angle of aperture, and that consequently the rays of all oblique pencils were to be excluded, as these might cross at a point not coincident with the principal focus, and being measured separately, might form an angle (apparently of aperture) not coinciding of course with the true one, although, perhaps, not differing from it in amount. A short description of the usual method of measuring these angles will suffice to show what claim it has to confidence in these respects. The microscope, with the object-glass to be examined, and an ordinary eye-piece is used as a telescope, and a light placed at some distance is commonly made an object to define the limit of the field of view, the image of which is formed near the back surface of the posterior combination, and the different light of this image as run through the eye-piece is the indication that a pencil of light is admitted, whether central or oblique. Sometimes, by an additional glass, the eye-piece is made an evicting one capable of bringing the image into focus. This adds much to the convenience of the method. Thus, the conditions of the microscopic object-glass are reversed, the principal focus being transferred from the front to the back, and the rays estimated are those of the extreme oblique pencils, which may or may not pass through the point of the principal focus of the glass when used for the microscope. The author was led to adopt this new method by a beautiful experiment made by Professor Faraday some time ago at the Royal Institution, of the effect of glare produced by placing a piece of white muslin, blackened in parts, before a white paper, printed in large letters. With the white muslin in front the letters were scarcely visible, while through the blacked parts they resumed their natural appearance.

Professor Kelland has had executed in Paris some extraordinary Microscopic Writing. On a spot no larger than the head of a small pin, the Professor shows, by means of powerful microscopes, several specimens of distinct and beautiful writing—one of them containing the whole of the Lord's Prayer executed within this minute compass. In reference to this, two remarkable facts in Layard's last work on Nineveh show that the national records of Assyria were written on square bricks, in characters so small as to be scarcely legible without a microscope; and that, in fact, a microscope was also actually found *in the ruins.* Sir John Herschel has since suggested that our

own national records might be daguerreotyped and multiplied for preservation on a minute scale, perusible only by the use of the microscope.

VALUE OF THE MICROSCOPE FOR DETECTING THE BEST KINDS OF WOOL FOR FELTING.

MICROSCOPIC discoveries have been made within the last few years which have led to a revelation of much of the mystery of Felting. Examined through a powerful microscope, the short fibres exhibit the appearance of a continuous vegetable growth, from which there are sprouting, and all tending in one direction from the root to the other extremities, numerous leaves like calices or cups, each terminating in a short point. It is easy to perceive how easily one of these fibres will move in the direction from root to point; while its retraction must be difficult, being obstructed by the tendency of the little branches. In a fibre of merino wool, the number of these reversions or projections amounted to 2400 in the space of one inch. In a fibre of Saxon wool, of acknowledged superior felting quality, there were 2720 senations. Southdown wool, being inferior to those two for felting power, only contained 2080 senations in one inch of fibre, while Leicester wool contained no more than 1860 in one inch; and Leicester wool is known to be little adapted for felting purposes.

ORIGIN OF THE DIAMOND.

SIR DAVID BREWSTER ascribes the origin of the Diamond to a slow decomposition of plants. He met with a diamond which contained a globule of air, while the surrounding substance of the diamond had a polarizing (doubly refracting) structure, displayed by four sectors of polarized light encircling the globule. He therefore inferred that this air-bubble had been heated, and, by expansion, had produced pressure on the surrounding parts of the diamond, and thereby communicated to them a polarizing structure. Now, for this to have happened, the diamond must have been soft and susceptible of compression. But as various circumstances contribute to prove that this softness was the effect of neither solvents nor heat, he concluded that the diamond must have been formed, like amber, by the consolidation of vegetable matter, which gradually acquired a crystalline form by the influence of time and slow action of corpuscular forces.—*Pereira's Lectures on Polarized Light*.

THE KOH-I-NOOR DIAMOND.

PROFESSOR TENNENT has detailed to the British Association, the recutting of the Koh-i-noor Diamond. After dwelling awhile on the history of "The Mountain of Light," and the reasons why it was recut, he stated that the process had occupied thirty-eight days, that it was now free from any defects or flaws, weighed nearly 123 carats, and that its calculated value was 83,232*l*. Mr. Tennant then entered upon an exposition of the tricks frequently played by dishonest dealers, who substitute white topazes, or even pieces of rough crystal, for diamonds, or who sell to the frequenters of watering-

places pieces of glass as sapphires. He stated that the "adamant" described by Pliny was a sapphire, as was proved by its form; and by the fact that, when struck on an anvil by a hammer, it would make an indentation in the metal. A true diamond, under such circumstances, would fly into a thousand pieces.

DISCOVERY OF PURE ALUMINIUM.

M. DUMAS has communicated to the Paris Academy of Sciences, the means of *obtaining a metal from clay*. The merit of the discovery is due to M. H. Sainte Claire Deville, of the Normal school of Paris, and is thus described by M. Dumas in the *Comptes Rendus*:—"It is known that M. Wohler has obtained aluminium in a state of powder, by treating its chloruret by potassium. In modifying in a proper way the process of that gentleman, we may regulate the decomposition of the chloruret of aluminium in such a manner as to produce an incandescence sufficient to cause the particles of this metal to agglomerate into globules. If the mass composed of the metal, and of the chloruret of sodium (it is better to employ sodium) be taken, and if it be heated in a porcelain crucible to a red heat, the excess of the chloruret of aluminium becomes disengaged; and there remains a saline mass of acid reaction, in the midst of which there are globules, more or less large, of perfectly pure aluminium. This metal is as white as silver, and is malleable and ductile in the highest degree. However, when it is wrought, it resists strongly, and it may be supposed that its tenacity approaches that of iron. It may be hardened by hammering, aud the hammering restores its smoothness. Its point of fusion is but little different from the point of fusion of silver. Its density is 2.56. It may be melted and cast in the open air, without its sensibly oxydising. It is a good conductor of heat. Aluminium is completely unchangeable by dry or damp air; it does not become dull, but remains brilliant by the side ot zinc and tin freshly cut, which lose their brilliancy. It is insensible to the action of sulphuretted hydrogen. Cold water does not affect it; boiling water does not tarnish it. Nitric acid, whether weak or concentrated, and weak sulphuric acid, employed cold, do not act upon it. Its veritable dissolvent is chlorohydric acid; it then disengages hydrogen, and a sesquichloruret of aluminium becomes formed. Heated to redness in gaseous chlorohydric acid, it produces a dry and volatile sesquichloruret of aluminium. It will be understood that a metal white and unchangeable as silver, which does not blacken in the air, which is fusible, ductile, and tenacious, and which presents the singular property of being lighter than glass, would be of great utility if it were possible to obtain it easily. If we consider, besides, that this metal exists in large proportions in nature, and that its ore is clay, we must wish to see it become of common use. I have every reason to believe that this may be the case; for the chloruret of aluminium is decomposed with remarkable facility at a high temperature by common metals, and a reaction of this *nature, which I* am experimenting at this moment on a large

scale than a simple experiment in a laboratory, will solve the question in a practical point of view."

Mr. C. M. Willich, in the *Journal of the Society of Arts*, observes, upon this novelty:—"The discovery of an easy mode of procuring this *noble* metal from clay, which is so abundant in the world, would open the way to fame and fortune for the discoverer. The accompanying simple experiment has been made by M. Chapelle, who, as soon as he heard of M. Deville's discovery of the pure metal aluminium, made the following trial:—He introduced pulverized clay, with marine salt and powdered charcoal, into a common crucible, and heated it in a reverberatory furnace by means of coke, but he did not succeed in obtaining a white heat. After cooling, the crucible was broken, and in the mass a considerable quantity of small globules (about half a millimetre in diameter, or about 1-50th of an inch,) were found, of the colour of silver. He did not ascertain if these globules were quite pure; he, however, states that they were insoluble in cold nitric acid, but were soluble in muriatic acid heated to 60°."

PHENYL.

DR. A. WILLIAMSON has communicated to the Royal Society a paper, "On some new compounds of Phenyl." This paper contains a notice of some of the results obtained in an investigation of carbolic acid or hydrated oxide of phenyl, conducted, under the author's superintendence, by Mr. Scrugham in the Analytical Laboratory of University College. Referring to the substitution products obtained by Laurent from hydrate of phenyl by the action of chlorine and bromine, as well as to its combination with acids prepared by that chemist in conjunction with Gerhardt, the author states that the substance which they conceived to be chloride of phenyl has been found by Mr. Scrugham to be a mixture of two compounds. As regards the preparation of hydrate of phenyl from the creasote of coal tar, it is observed that the numerous fractional distillations by which it is usually isolated may be abridged by crystallization; for if creasote, having the boiling point between 186° and 188° Cent. be left for some time in contact with a few crystals of pure hydrate, it deposits a considerable quantity of beautiful colourless needles, which when separated from the mother liquid, distil at 184° Cent., and condense in the neck of the retort into a solid mass of pure hydrate of phenyl. When pentachloride of phosphorus is added to hydrate of phenyl, the action is at first very energetic, hydrochloric acid being evolved, and the mixture becoming hot; but after a time the addition of fresh portions of pentachloride produces no perceptible action, unless the mixture be heated. Oxychloride of phosphorus is formed, as well as a neutral oily body, which is insoluble in aqueous potash at the common temperature, but soluble with decomposition in boiling. This oily compound would, from its mode of formation, be naturally supposed to be the chloride of phenyl, and it has been so considered by some distinguished chemists. It may, however, be separated by distillation into two perfectly definite and distinct bodies, one of which boils at 136° Cent., the other at a temperature

above the range of mercurial thermometers. The former of these is a colourless mobile liquid, possessing a fragrant smell, not unlike that of bitter almonds. The latter is a more consistent inodorous liquid, which solidifies at a low temperature into a mass of colourless crystals. The liquid having the boiling point of 136° is nothing else than the *chloride of phenyl.* The crystalline body is the *phosphate of phenyl,* one of the most beautiful products in organic chemistry. In the liquid state it is slightly yellow by transmitted light, and it reflects the more refrangible rays with a fine opalescent appearance, due, no doubt, to the so-called epipolic refraction. The epipolic rays visible by ordinary daylight on and at some depth below its surface, are of a fine violet tint, differing decidedly from the blue colour exhibited by disulphate of quinine in like circumstances. The flame of sulphur does not bring out this effect more strongly than the diffused light of the sun.—*Proceedings of the Royal Society.*

THE TORBANEHILL NEW MINERAL.

THERE has been lately tried in the Court of Queen's Bench, before the Lord Chief Justice Campbell and a special jury, a case that had an important reference to the value of this new and now very celebrated mineral. The case is titled in the full reports which have been made of it, "Young *v.* White and others," and the parties to the action were Messrs. Young, Binney and Meldrum, manufacturing chemists near Bathgate, plaintiffs; and Messrs. White and Co., gas manufacturers and manufacturing chemists, Manchester, defendants. It appears from the reports of the trial that the plaintiff, James Young, on being sworn, deposed that he "manufactured and sold at the rate of 8000 gallons a week" of the Paraffine Oil, which is procured from the Torbanehill new mineral. 8000 gallons a week are 416,000 gallons a-year, and accordingly Mr. Young's counsel, Mr. Bramwell, stated that his client sold (in round numbers) "400,000 gallons of this oil yearly," Mr. Bramwell adding, "at 5s. per gallon." That is, Mr. Young stated, while his counsel repeated the statement, that from the chemical works near Bathgate which prepare the Paraffine oil procured from the Torbanehill mineral, there are sold of that valuable oil 100,000*l.* worth yearly, and it is to be borne in mind that the greater portion of this very large yearly sum is clear profit. Young and Co. are only one of the many parties in this country, and all over the world, who order and obtain the Torbanehill mineral. Of what immense value must it then be in a commercial point of view!—*Edinburgh Witness; Literary Gazette,* No. 1970.

DOLOMITE.

M. J. DUROCHER has obtained Dolomite artificially through the action of magnesia vapours. He put in a gun-barrel some anhydrous chloride of magnesium, and a porous carbonate of lime, the latter being so placed that it could be reached only by vapours from the former. The gun-barrel was closed, and then kept at a low red heat for three hours. The limestone when taken out was partly scoriaceous externally, and covered with a mixture of chloride of calcium,

and chloride of magnesium within; it was altered mostly to a dolomite, as ascertained by analysis.—*American Journal of Science and Arts*, No. 49.

ARCTIC MINERALS.

SIR RODERICK MURCHISON observes: "Judging from a memoir communicated by M. Lundt of Denmark, and lately read to the Geographical Society by Sir Walter Trevelyan, 'On the mineral produce of the southern parts of Greenland,' we have every reason to think that valuable ores of copper may be found to extend far to the north of the tracts around Disco, where the minerals in question were observed. Judging from the few rocks submitted to my inspection by Captain Inglefield, and which were collected in the more northern parallel of 77°, I should infer, from their crystalline character, that a very large portion of this region may prove to be metalliferous, and that industry may there be rewarded with spoils of the land, as well as by catching the whales and seals of the sea."—*Address to the Royal Geographical Society.*

RADIANT HEAT.

PROFESSOR DOWELL has communicated to the British Association his report "On Radiant Heat." The researches of Melloni (now no more) and of Knoblanch were described; and the conversion of the former to the opinion, that light and radiant heat differ from each other only in the length of their undulations, was referred to. The most recent results of Knoblanch are, that certain bodies possess the power of permitting heat to radiate through them in different quantities in different directions. The Professor concluded by an analysis of a recent paper by Professor Wm. Thomson.—*Literary Gazette*, No. 1370.

ON MELTING POINTS.

MR. B. C. BRODIE has read to the Royal Institution a paper upon this inquiry, limiting his illustrations to substances that melt at low temperatures; as his object was not to indicate the differences in the Melting Points of various solids, but to point out the general phenomena during the change from solidity to liquidity under the influence of heat. The absorption of heat, or, as it is generally considered, the production of cold whilst a solid is melting, is common to all processes of liquefaction; and the contrary effect of the evolution of heat attends all the processes of solidification. Similar effects are produced in various degrees, whether the substance operated on be iron, ice, or a soluble salt. Commencing with ice, Mr. Brodie took occasion to expose a fallacy which had been approvingly adopted by the *Quarterly Review*, from a recent work on natural philosophy, relative to the frigorific value of Wenham Lake ice compared with ice produced at only a few degrees below the freezing point. It had been dogmatically stated, as if in correction of a popular error, that ice formed in a temperature several degrees below Zero must produce a *greater degree* of cold when melting than the ice of this country; but,

as Mr. Brodie observed, it would be just as rational to suppose that a stone brought from the West Indies must give out more heat than another. The temperature of the ice would undergo variation when brought into a different climate as readily as a stone, and the real frigorific effect is only produced by change of state from a solid to a fluid. When this change can be effected rapidly, without the addition of heat, then the temperature is reduced in a greater degree, and the freezing effect is increased. When water is added to ice, there is no increase of cold, because the liquid solidifies at the freezing point, and the melting process ceases; but the addition of alcohol, which cannot be frozen, occasions a rapid absorption of heat, and the temperature of the melting ice falls many degrees below the freezing point, as is exemplified by freezing water in a mixture of ice with alcohol. In the same manner the addition of ice to spirituous liquors, as in the drink called "sherry cobbler," produces a greater degree of cold than when the same quantity of ice is added to water. The melting points of bodies vary materially with the conditions in which they have been solidified. No substance presents greater anomalies in this respect than sulphur, the melting point of which varies as much as 10 degrees between one form of crystallization and in its powdered state. Several experiments were performed to show these peculiarities, and also the effect of mechanical action in suddenly solidifying liquid sulphur when approaching the lowest melting point. Mr. Brodie said that the cause of these anomalies is as yet but imperfectly understood; but he is inclined to attribute the varying melting points of sulphur to peculiar molecular conditions in the different forms it assumes. The production of cold by the solution of crystalline salts, was instanced as analogous to the frigorific effect of melting, but Mr. Brodie did not enter into an examination of the theories assigned to explain the cause of the evolution and absorption of heat by change of state.

COLOUR OF THE OCEAN.

THE usual tint of the Mediterranean Sea, when undisturbed by accidental or local causes, is a bright and deep blue; but in the Adriatic a green tinge is prevalent; in the Levant basin it borders on purple, while the Euxine often has the dark aspect from which it derives its modern appellation. The clear ultramarine tint is the most general, and has been immemorially noticed, although the diaphanous translucence of the water almost justifies those who assert that it has no colour at all. Seamen admit of one conclusion in regard to colour —namely, that a green hue is a general indication of soundings, and indigo blue of profound depth.—*Rear-Admiral Smyth on the Mediterranean.*

PRESSURE BORNE BY ANIMAL LIFE IN PROFOUND DEPTHS.

THE real amount of Pressure borne by Animal Life in Profound Depths is truly an interesting element for consideration and experiment. *At 16 fathoms,* a living creature would have to sustain only *about 60 pounds to the* square inch; and at 60 fathoms as much as

180 pounds. At 100 fathoms depth the pressure would amount to 285 pounds; and at 700 fathoms the creature must bear with impunity a quantity equal to 1830 pounds upon the square inch; while the pressure of 1000 fathoms of superincumbent water on the same area considerably exceeds a ton.—*Rear-Admiral Smyth on the Mediterranean.*

THE GEYSERS OF ICELAND.

Dr. Stevenson Macadam has proposed to the British Association a new theory for the intermittent action of the Geysers of Iceland. It was dependent on the spheroidal form which liquids assume when falling on strongly heated surfaces, and required the supposition of a double cavity in the course of the stream through the earth. A vigorous discussion ensued. The President and Mr. Forbes brought forward various objections; and Dr. Gladstone contended that Bunsen's theory was everything that could be desired, as it involved nothing that was hypothetical; but Dr. Macadam stoutly maintained the applicability of his views to the phenomena in question.

ARSENIC-EATERS OF LOWER AUSTRIA.

Dr. Tschudi, in a letter to the *Gazette des Hôpitaux*, says: "Nearly all the inhabitants, particularly in the mountains adjoining Hungary, are in the habit of eating Arsenic. They purchase it under the name of *hedri* from travelling pedlers, who procure it from workmen at the glass-factories, from veterinary-surgeons, &c. The effect of the poison, when taken in moderate quantities, is to give a freshness to the complexion, and afterwards to impart a certain degree of embonpoint. But the number of deaths, in consequence of taking too much of the article, is by no means inconsiderable. Each ecclesiastic can cite examples of these deaths, though to arrive at the knowledge of them is not easy, as, whether through fear of the law which forbids any one to keep arsenic in his possession, or through a consciousness of doing wrong, the arsenic-eaters conceal as much as possible their habit of using it; it is only on the bed of death that they confess what they have done. Another advantage which the arsenic-eaters derive from the use of the poison is to have their respiration facilitated in ascending the mountains. Whenever they are about to set out on a long excursion, they place a little piece of arsenic in their mouth, and the effect produced is really marvellous, as they ascend the greatest heights with ease. I may add, that bearing this fact in mind, I have administered arsenic in cases of asthma with success. The quantity with which the arsenic-eaters commence is a piece about the size of a pea. They take it in the morning fasting, and augment the dose insensibly. A peasant, whom I was well acquainted with, takes at present about four times that quantity, and enjoys good health. He has been indulging in the habit for forty years; his father did the same before him, and his sons will probably follow the example thus offered to them. The habit of the grooms and coachmen at Vienna of giving arsenic to their horses is well known. They sometimes throw a pinch of it amongst the oats, and sometimes

tie up a small bit in a linen rag, which they attach to the bit when the horse is harnessed. The saliva dissolves the poison, and the horse evidently delights in it. The effect on horses of taking it is to make them in high condition, with the skin smooth and shining, and to increase their spirit. The carters in the mountainous countries of Austria are also in the habit of giving arsenic to their horses when about to ascend a steep road, and the effect is really marvellous, as the animals go along with extraordinary ease. It is, however, worthy of remark, that though arsenic may be given to a horse for years without any injury arising, if the habit is interrupted, the animal at once falls off, loses its appetite, and no matter what quantity of food may be given it, never regains its strength, healthy appearance and courage."

ON THE CHANGES PRODUCED IN THE BLOOD BY THE ADMINISTRATION OF COD-LIVER OIL AND COCOA-NUT OIL.

DR. THEOPHILUS THOMPSON has found that during the administration of Cod-liver Oil to phthisical patients their blood grew richer in red corpuscles; and he refers to a previous observation of Dr. Franz Simon to the same effect. The use of almond-oil and of olive-oil was not followed by any remedial effect; but from Cocoa-nut oil results were obtained almost as decided as from the oil of the liver of the cod, and the author believes it may turn out to be a useful substitute. The oil employed was a pure cocoa oleine, obtained by pressure from crude cocoa-nut oil, as expressed in Ceylon and the Malabar coast from the *Copperah* or dried cocoa-nut kernel, and refined by being treated with an alkali and then repeatedly washed with distilled water. It burns with a faint blue flame, showing a comparatively small proportion of carbon, and is undrying.

The analysis of the blood was conducted by Mr. Dugald Campbell. The whole quantity abstracted having been weighed, the coagulum was drained on bibulous paper for four or five hours, weighed and divided into two portions. One portion was weighed and then dried in a water-oven, to determine the water. The other was macerated in cold water until it became colourless, then moderately dried and digested with ether and alcohol to remove fat, and finally dried completely and weighed as fibrine. From the respective weights of the fibrine and the dry clot that of the corpuscles was calculated. The following were the results observed in seven different individuals affected with phthisis in different stages of advancement:—

		Red corpuscles.	Fibrine.
First stage, before the use of cod-liver oil	Female	129·26	4·52
	Male	116·53	13·57
First stage, after the use of cod-liver oil	Female	136·47	5·00
	Male	141·53	4·70
Third stage after the use of cod-liver oil	Male	138·74	2·23
Third stage, after the use *of cocoa-nut oil* . . .	Male	139·95	2·31
	Male	144·94	4·81

Proceedings of the Royal Society.

THE ROYAL SOCIETY.

On St. Andrew's Day (Nov. 30), the anniversary meeting of the Society was held; the Earl of Rosse, President, in the chair.

His Lordship delivered his annual address, in which he passed under review the scientific labours of the Society during the past year, and the progress of science generally. He adverted to the flourishing financial condition of the Society, which, besides estates, possesses 37,000*l.* in the funds. The annual grant from Government of 1000*l.* enables the council to render great service to scientific men, by grants of money in aid of their scientific investigations.

His Lordship then delivered the medals which had been awarded to the following gentlemen:—

The Copley medal was awarded to Professor J. Müller, of Berlin, for his important contributions to different branches of physiology and comparative anatomy, and particularly for his researches on the embryology and structure of the Echinodermata, contained in a series of memoirs published in the Transactions of the Royal Academy of Berlin.

One of the Royal medals was then presented to Dr. Hooker, for his researches in various branches of science, especially in Botany, as naturalist of the Antarctic expedition of Sir James Ross, and in an expedition to the eastern part of the Himalaya range; and as an acknowledgment of his valuable scientific investigations in the department of natural history.

The second Royal medal was awarded to Dr. Hofman, professor in the Royal College of Chemistry, for his researches in Organic Chemistry, published in the Transactions of the Royal Society.

The Rumford medal was presented to Dr. Arnott for his improvements in the practice of Heating and Ventilation generally, and particularly for the successful construction of a new smoke-consuming and fuel-saving fire-grate.

The election of new council and officers then took place, and the following nobleman was declared duly elected:—

President—Lord Wrottesley, M.A.

The Earl of Rosse, in retiring from the chair, which he had occupied for six years, thanked the Society for the honour that they had conferred upon him by re-electing him annually to the office of president during that period.

THE FRENCH ACADEMY OF SCIENCES.

At the Annual Sitting, held in January, 1855, the following prizes were awarded. That for Astronomy, founded by Lalande, was divided amongst MM. Luther, belonging to the observatory of Blik, near Dusseldorf; March, attached to Bishop's observatory at London; Hind, belonging to the same observatory; Ferguson, attached to the observatory of Washington; Hermann Goldschmidt, historical painter; and Chacornac, attached to the observatory of Paris; each of these observers having discovered a small planet in 1854. The prize of Statistics, founded by M. de Montyon, was

divided amongst three persons: M. Denamial, juge-de-paix at Rivesaltes (Pyrénées Orientales), for statistical tables relative to the courts of justice of that canton; M. Edouard Grar, for his collection of facts relating to the working of the coal mines of French Hainault from 1716 to 1791; and lastly, the Statistical Commission of the canton of Brenfeld, for the Agricultural Statistics of that canton drawn up by M. Guérin, its secretary. The prize founded by the Marquise de Laplace, for the pupil who should have obtained the first place in leaving the Polytechnic School the preceding year, was gained by M. Marin. The prize for Experimental Physiology was awarded to M. Davainne, for his inquiries into the reproduction and development of Mollusca. The Cuvier prize was given to M. Müller, author of an extensive work on the development of Echinodermata. Three prizes were given for matters connected with Insalubrious Arts: one of 2500fr. to M. Rouy, gunsmith, for substituting potato-starch for powdered charcoal in the preparation of moulds intended to receive smelted copper, bronze, and iron; a second of 1500fr. to M. Fontenau, inventor of a piece of mechanism calculated to render less dangerous the use of percussion fowling-pieces; and a third of 1500fr. to M. Mabru, inventor of a plan for preserving milk without the addition of any extraneous substance. Several prizes were also awarded for improvements in Surgical Instruments and works on Medical Science; after which M. Laugier read a biographical notice, composed by the late M. Arago, of Malus, famed for several discoveries in natural philosophy.

MEASURING THE FORCE OF THE SUN'S LIGHT.

It is well known that paper prepared for photography grows more or less black by rays of light falling on it. M. Schall, a young painter, of Berlin, has taken advantage of this property in photographic paper to determine the intensity of the Sun's Light. After more than 1500 experiments, M. Schall has succeeded in establishing a scale of all the shades of black which the action of the sun produces on the photographic paper; so that, by comparing the shade obtained at any given moment on a certain paper with that indicated on the scale, the exact force of the sun's light may be determined. Baron Alexander von Humboldt, M. de Littnow, M. Dove, and M. Poggendorff, have congratulated M. Schall on this invention, which will be of the highest utility, not only for scientific labours, but also in many operations of domestic and rural economy.—*Jameson's Journal*, No. 111.

Electrical Science.

ELECTRICITY AND ITS USES.

In a late number of the *Revue des Deux Mondes*, appeared an article entitled "L'Electricite Ouvriere," by M. Babinet, member of the French Institute, enumerating the various effects already produced through the agency of Electricity; whether artistic, scientific, or industrial. The learned writer traces his subject through all its phases, physiological, philosophical, chemical, motive power, light, heat, telegraphic, smelting, and working of ores for the separation of metals, molecular actioh, electro-plating, galvano-plastic, &c. At present, the chief and almost the only means employed in all the various uses to which Electricity has been applied is the Voltaic agency, which is of too troublesome and expensive a character to admit of Electricity being more universally used than it is, and undoubtedly would be, were a cheaper and easier medium obtainable.

This important desideratum is on the eve of consummation, by Mr. Shepard's Magneto-Electric Machines, which have lately been put up on an extensive scale at the palace of the *Hôtel des Invalides*, in Paris, and which have overcome all the difficulties hitherto felt by producing an immense quantity of Electric fluid at little cost and trouble. Many scientific persons who have seen these machines, speak highly of their astonishing powers; and among them, M. Felix Brooks, who thus introduces the subject—

"The most marvellous, without contradiction, is Shepard's process, which produces a Gas for Heating and Lighting by means of the decomposition of water by Electricity. Water, as is well known, is composed of the two gases, oxygen and hydrogen. A revolving apparatus, with helices of copper wire, is brought in contact with a magnet, which, when in movement, produces the electric current; and this, by means of conducting wires, decomposes the water, disengages the oxygen, which is neutralized by an absorbing substance; when the hydrogen united with a hydro-carbon becomes an agent of light and heat. The force of one man can produce sufficient gas to supply seven ordinary burners in as many minutes, at an expense of half the price of ordinary coal gas. Hitherto, the difficulty of the preparation of gas, as well as the high price of its manufacture, has prevented its general use. The apparatus which we have seen in operation at the *Hôtel des Invalides* gives a very different idea of a gas work from what has hitherto been seen. In place of the black, unsightly manufactory of coal gas, we have here seen a saloon containing an elegant display of magneto-electric machines. We have admired this instantaneous manufacture of a gas, powerful, and exempt from all deleterious emanations, by means of an element the most common in the world, with the aid of water and electricity. Heating by this means will one day take the place of *coal and wood;* not only for domestic uses, but for the engines of our

manufactories and our vessels. For our navy what immense benefits will accrue by the substitution of a simple magneto-electric machine in lieu of the immense space now taken up by coal. Take for instance out of the hundred or more divers applications of electricity a special one which we know will save millions by its employment, viz., the *Separation of Metals*, and on which a company is now occupied at the *Hôtel des Invalides*.

What may not be expected from a magneto-electric power equivalent to fifteen thousand couples of Bunsens? and what real miracle will not result from a dynamic action as unlimited as mysterious.

ELECTRICITY IN CHEMICAL ACTIONS.

M. BECQUEREL, from facts detailed in a memoir in the *Comptes Rendus*, April 24, 1854, "On the principles which govern the Disengagement of Electricity in Chemical Actions," deduces the following consequences:—

1. In all chemical reactions electricity is disengaged.

2. In the reactions of acids or acid solutions with metals or alkaline solutions, the acids and acid solutions always take an excess of positive electricity, the metals and alkaline solutions a corresponding excess of negative electricity.

3. The disengagement of electricity during combustion is governed by the same principle: that is to say, the combustible body disengages negative, the burning body positive electricity.

4. Decompositions produce inverse electrical effects.

5. There is no disengagement of electricity unless the two bodies are conductors of electricity; thus in the combination of a metal with dry oxygen, iodine or bromine, there is no production of electricity.

6. In the mixture of acids with water, or in their combination with that fluid, the water acts as a base, whilst it acts as an acid in relation to alkaline solutions.

7. Concentrated solutions of neutral salts act towards water in regard to the electrical effects produced in the same manner as acids with bases.

8. Acids when combining or mixing with each other behave so that the most oxidizing acids are the most electro-positive; in combination with bases they appear to retain the same property, so that in the reaction or mixture of saturated solutions of two neutral salts, the nitrate is positive in relation to the sulphate, the sulphate to the phosphate, &c.

9. When several acid, neutral, or alkaline solutions are placed side by side so as to mix slowly, the electrical effects produced are the sum of the individual effects which take place at each surface of contact.

10. Contrary to Volta's opinion, an electric circuit, or rather a closed circuit, may be formed entirely with liquids in which a current of electricity circulates, and from which phenomena of decomposition and recomposition are produced, if there exist in this circuit corpuscles which are conductors of electricity. Living organized bodies present numerous examples of circuits of this kind, capable of giving rise to

electro-chemical effects which have not yet been studied.—See the entire memoir in the *Philosophical Magazine*, No. 49.

GENERATION OF ELECTRICITY.

MR. ADIE, of Liverpool, relates in *Jameson's Journal*, No. 113, the following, on the authority of a credible eye-witness, who saw the process. A lady in New York undertook to light the gas by an electric spark: she shuffled her slippers over the carpet for a few seconds, and then approached the jet of the gas-pipe; the gas was turned on, and the finger held near the nozzle of the burner, to allow an electric spark to pass from it, which generally ignited the gas. The success of the experiment was of course influenced by the dryness of the atmosphere; but on the North American continent, a state of the air fit for such a purpose is, it would seem, by no means uncommon. In this country a similar experiment for lighting gas by an electric spark from the finger is often enough performed; but our climate requires the aid of an electrical machine and an insulated stool.

PRODUCTION OF PYRO-ELECTRIC CURRENTS.

M. BECQUEREL has succeeded in producing currents which he calls Pyro-electric Currents, by analogy with the currents obtained in the ordinary batteries, and to distinguish them from the thermo-electric currents, which are due to heat alone. These currents, which have a constant power as long as the temperature does not vary very sensibly, are produced whenever solid metallic or other substances, conductors of electricity, are in contact with glass or any other vitreous substance in a state of igneous fusion, or softened by heat; but the greatest effect takes place only when the substance is fused.—*Comptes Rendus; Philosophical Magazine.*

ELECTRIC PRINCIPLES DEVELOPED BY THE TELEGRAPH.

PROFESSOR FARADAY, in the opening lecture of the session of the Royal Institution, on January 13, 1854, very ably illustrated the Development of Electrical Principles produced by the working of the Electric Telegraph. There was an extensive apparatus of voltaic batteries, consisting of 450 pairs of plates, supplied by the Electric Telegraph Company; and eight miles of wire, covered with gutta percha, four miles of which in coils were immersed in tubs of water, to show the effects of submersion on the conducting properties of the wire in submarine operations. The principal point which Professor Faraday was anxious to illustrate was the confirmation which experiments on the large scale of the electric telegraph have afforded of *the identity of dynamic or voltaic electricity with static or frictional electricity.* In the first place, however, he exemplified the distinction between conductors and non-conductors, impressing strongly on the audience that no known substance is either a perfect conductor of electricity or a perfect non-conductor; the most perfect known insulator transmitting some portion of the electric fluid, whilst metals, the best conductors, offer considerable resistance to its trans-

mission. Thus the copper wires of the submarine electric telegraph, though covered with a thickness of gutta percha double the diameter of the wire, permit an appreciable quantity of the electricity transmitted to escape through the water; but the insulation is, nevertheless, so good that the wire retains a charge for more than half an hour after connexion with the voltaic battery has been broken. Professor Faraday stated that he had witnessed this effect at the Gutta Percha Works, where one hundred miles of wire were immersed in the canal. After communication with a voltaic battery of great intensity, the wire became charged with electricity, *in the same manner as a Leyden jar;* and he received a succession of forty small shocks from the wire, after it had been charged and the connexion with the battery broken. No such effect takes place when the coils of wire are suspended in the air, because in the latter case there is no external conducting substance. The storing-up of the electricity in the wire when immersed in water is exactly similar to the retention of electricity in a Leyden jar, and the phenomena exhibited corresponded exactly with those of static electricity; proving in this manner, as had previously been proved by charging a Leyden jar with a voltaic battery, that dynamic and static electricity are only different conditions of the same force; one being great in quantity but of low intensity, whilst the latter is small in quantity but of great intensity. Some interesting facts connected with the conduction of electricity have also been disclosed by the working of the submarine telegraph, which Professor Faraday said confirmed the opinion he had expressed twenty years ago, that the conducting power of bodies varies under different circumstances. In the original experiments by Professor Wheatstone to ascertain the rapidity with which electricity is transmitted along copper wire, it was found that an electric spark passed through a space of 280,000 miles in a second. Subsequent experiments with telegraph wires have given different results, not arising from inaccuracy in the experiments, but from different conditions of the conducting wires. It has been determined that the velocity of transmission through iron wire is 16,000 miles a second, whilst it does not exceed 2700 miles in the same space of time in the telegraph wire between London and Brussels, a great portion of which is submerged in the German Ocean. The retardation of the force in its passage through insulated wire immersed in water is calculated to have an important practical bearing in effecting a telegraphic communication with America; for it was stated that, in a length of 2000 miles, three or more waves of electric force might be transmitting at the same time, and that if the current be reversed, a signal sent through the wire might be recalled before it arrived in America.

Prof. Faraday then exhibited this experiment illustrative of the identity of voltaic and frictional electricity. The terminal wires of a powerful secondary-coil apparatus were placed seven inches apart within the receiver of an air-pump; and when the receiver was exhausted, a stream of purple-coloured light passed between the wires, resembling, though more continuous and brilliant, the imita-

tion of the aurora borealis produced when an electric spark is passed through an exhausted glass tube. The voltaic power employed to produce this effect of static electricity was only three cells of a Grove's battery.

MECHANICAL ACTION AND ELECTRIC TRANSFER.

MR. A. CROSSE, in a paper read by him to the British Association, states that he has found that by electrifying a sovereign positively in close contact with a piece of carbonate of lime, under nitric acid diluted with fifty times its quantity of water, a portion of the milled edge of the coin was struck off in pieces, some of which were large enough to retain the milled edge upon them distinctly. The voltaic action was kept up for fifty hours; and at the expiration of that time the coin had lost fifty grains in weight; a ground glass rod that used to keep the coin in contact with the limestone was permanently gilded; and this took place at the positive pole. The weight of the portions removed from the coin exactly corresponded with the deficiency. The solution being tested contained nitrate of lime, but no gold nor copper. Mr. Crosse likewise found, on repeating this experiment with sulphuric acid, similarly diluted,—the voltaic action being kept up for ninety hours,—that six grains of gold were removed from the edge of the coin; and the pieces broken off were the same. A strip of glass being placed on the edges of the jar containing the dilute acid, and half an inch above its surface, and in a line with the electric current, had its lower part covered with crystals of sulphate of lime, each one of which was at right angles to the electric current. The friction of the carbonic acid gas liberated from that part of the limestone in contact with the coin was apparently the mechanical cause of the removal of the edges. Mr. Crosse stated that he had made various experiments, both with frictional and voltaic electricity upon different substances, which, in his opinion, proved the effects of the mechanical action accompanying electric transfer.

ELECTRO-CHEMICAL DECOMPOSITION OF WATER.

WITH the hope of obtaining a gas much charged with ozone by the Electrolysis of Water, M. Leblanc arranged a voltameter so as to keep it in action in a freezing mixture. In this way, water containing at least one tenth of its volume of concentrated sulphuric acid was decomposed at a low temperature by means of four ordinary Bunsen's elements. Although the electrodes were formed of simple platinum wires, the volume of oxygen collected was much less than half the volume of the hydrogen disengaged in the same time as the negative pole.

The oxygen was strongly ozonized, but the proportion of ozone absorbable by spongy silver did not warrant the attribution of the diminution in the volume of gas collected at the positive pole to any difference in volume between ozone and ordinary oxygen.

M. Leblanc observed that the liquid in the voltameter had *acquired new* properties—energetic oxidizing action; it whitened

sulphuret of lead, and superoxidized hydrated oxides like oxygenated water.

He continued these researches, and ascertained the existence of some peculiar phenomena of oxidation, by employing spongy platinum at the positive pole, and placing oxidizable substances in the cold voltameter; such as acetate of potash, which was rapidly converted into the formiate, &c.—*Comptes Rendus ; Philosophical Magazine*, No. 51.

ELECTRIC WEAVING.

The Cavalière Bonelli, of Turin, has applied Electricity to Weaving, by an invention which is more simple, less embarrassing, and more economical, than the invention of Jacquard. By the present invention, instead of the numberless and expensive cartoons, either full or hollow, you see small iron bars magnetized only when invested with the voltaic current; so that while at every passage of the shuttle it was necessary to change a cartoon, it now suffices to vary the ways which give passage to the electric fluid ; and the loadstones change their action every moment, according as the teeth of the comb under which the design passes, and with which they correspond, rest upon the conducting or insulating substance. As the point of the pantograph reproduces a design diminished or enlarged, and as the point of Bain's telegraph exactly copies a signature at the distance of hundreds of miles, so the loom of Bonelli reproduces woven the designs which pass under the comb, and all this without rendering necessary a change in the thousands of Jacquard looms now existing, which, if desired, may be worked alternately with electricity and with cartoons. A loom on a small scale has been shown in operation at Turin, Genoa, Lyons, and Paris.

NEW ELECTRO-MAGNETIC ENGINE.

M. Becquerel, in the *Comptes Rendus* for May, 1854, thus describes a New Engine, invented by M. Marié Davy:—

In most of the Rotatory Electro-Magnetic Machines hitherto constructed, the moveable armatures pass rapidly before the fixed electro-magnets, following a line perpendicular to the axis, without coming into contact; thus the entire amount of work that might be obtained is not made use of. M. Froment, who has paid much attention to electro-magnetic motor apparatus, has, however, constructed a machine in which an interior wheel, furnished with armatures of soft iron, revolves upon the terminal faces of the fixed electro-magnets, so as to make use of the magnetic attraction even up to the point of contact of the magnetized surfaces; but this arrangement produces, during the action of the machine, a series of shocks or concussions, which are opposed to the construction of a powerful machine upon this model.

M. Marié makes the moveable electro-magnets or armatures revolve in such a manner as to approach the fixed electro-magnets in the direction of the axis up to the point of contact, without any shock. Upon this *principle* are constructed the two electromotive machines

described in his note, one of which has a continuous rotatory, the other an oscillatory, motion. We shall only refer to the former apparatus, of which he has prepared a model, which has worked in our presence.

This machine consists of sixty-three electro-magnets arranged at equal distances round a circle of wood, furnished internally with a circle of copper. All the electro-magnets have their axes directed towards the centre of the wheel, and their surface coincides with the concave surface of the copper circle.

In the interior of this large wheel there are two others, of which the radius is one-third of that of the former; these are also furnished with a circle of copper, and bear each twenty-one equidistant electro-magnets, of which the axes are directed towards the centre, and the polar surfaces coincide with the concave surface of the copper wheels; these little wheels can then revolve, without slipping, in the interior of the large wheel, and carry round by their movement the axle of the machine, which corresponds with the axis of the large wheel. The moveable electro-magnets come successively in contact with the fixed electro-magnets. The large and small wheels are furnished with teeth for the maintenance of the coincidence, when this is once established.

The machine is also provided with various pieces of apparatus for putting each of the electro-magnets successively in communication with the battery, and giving a different magnetization to the two electro-magnets at the moment when they act upon each other.

M. Marié has made a change which appears advantageous, by replacing the internal wheels by others, which, instead of bearing electro-magnets, are surrounded by a ring of soft iron, which forms the armature; the moveable portion is thus rendered lighter, and the teeth are rendered unnecessary. It is this modification of the machine that we have seen in action.

The circular electro-magnets of M. Nicklès will here find an interesting application; and, at our suggestion, M. Marié proposes to make some experiments with this addition, which will enable him to augment the power of the machine without increasing the expense.

The construction of the machine is somewhat affected by the inexperience of the maker, so that it required a battery of twenty-four Bunsen's elements to produce 1·23 horse-power. But, according to M. Marié's calculations, one of the same energy, or, perhaps, even one of less intensity, would be sufficient, with a machine of large size, to produce 300 times the power, seeing that the friction would not increase in the same proportion as the force of the machine; the means of electrical communication not being changed, and the power produced by the attraction of the magnets being capable of multiplication in a great degree, by making use of the electro-magnets formed of large cylinders of soft iron. The model was constructed with a view to show the relations between the effect calculated from the magnetic force developed in the electro-magnet, and the actual force produced. The proportion was as 4 to 3, which is already a very close

approximation, considering the numerous imperfections resulting from the bad construction of the machine.

ELECTRO-MAGNETIC MOTIVE POWER.

MR. G. E. DERING, of Lockley, Herts, has patented certain means of obtaining Motive Power from Electricity. The arrangement consists of a flat surface composed of a series of electro-magnets, on which is made to rock or roll by their galvanic action a cylinder, which either itself constitutes a keeper or armature for all the magnets, or carries, or has suspended to it, a number of armatures corresponding with the electro-magnets. The object of this arrangement is, that by a succession of small pulls, one long stroke is obtained; and thus the full power of every magnet is secured in succession, without the loss hitherto sustained in most arrangements for producing motive power.

ELECTRO-MAGNETIC ENGRAVING MACHINE.

THIS invention is somewhat on the principle of the well-known planing machine. The drawing to be copied and the plate to be engraved are placed side by side, on the moveable table or lid of the machine; a pointer or feeler is so connected, by means of a horizontal bar, with a graver, that when the bar is moved, the drawing to be copied passes under the feeler, and the plate to be engraved passes in a corresponding manner under the graver. It is obvious that in this condition of things, a continuous line would be cut on the plate, and, a lateral motion being given to the bed, a series of such lines would be cut parallel to and touching each other, the feeler, of course, passing in a corresponding manner over the drawing. If, then, a means could be devised for causing the graver to act only when the point of the feeler passed over a portion of the drawing, it is clear we should get a plate engraved, line for line, with the object to be copied. This is accomplished by placing the graver under the control of two electro-magnets, acting alternately the one to draw the graver from the plate, the other to press it down on it. The coil enveloping one of these magnets is in connexion with the feeler, which is made of metal. The drawing is made on a metallic or conducting surface, with a rosined ink or some other non-conducting substance. An electric current is then established, so that when the feeler rests on the metallic surface, it passes through the coils of the magnet, and causes it to lift the graver from the plate to be engraved. As soon as the feeler reaches the drawing, and passes over the non-conducting ink, the current of electricity is broken, the magnet ceases to act, and by a self-acting mechanical arrangement the current is at the same time diverted through the coils of the second magnet, which then acts powerfully and presses the graver down. This operation being repeated until the feeler has passed in parallel lines over the whole of the drawing, a plate is obtained engraved to a uniform depth, with a fac-simile of the drawing. From this a type-metal cast is taken, which, being a reverse in all respects of the engraved plate,

is at once fitted for use as a block for surface printing. The machine is the invention of Mr. William Hansen, of Gotha.—*Journal of the Society of Arts.*

HOUSE STRUCK BY LIGHTNING AT BROMLEY.

On the afternoon of May 23, 1854, at about half-past two o'clock, an electric cloud passed over the east of the town of Bromley. A slight shower of rain began to fall, and suddenly the lightning flashed from the cloud, followed immediately by a most alarming peal of thunder. The lightning struck the chimney of a house at the end of a pile of buildings in Fulledge Meadow. One of the tile chimney-pipes was broken to pieces, and another was cracked. Descending the front chamber flue, the lightning passed out in two places of the chimney-piece; one on the side next the window, which was open at the time, and the other in front, about a foot above the mantel-piece, forcing off a considerable portion of the plaster in each case. A small looking-glass, which was hung up in the front, a little on one side of and below the point where the lightning passed, was thrown to the opposite end of the room, and shivered to atoms; as was also a smelling-bottle, which stood near the glass. The part of the wall where the glass hung was much discoloured, as if by the action of fire. A silver watch, which hung close by, was not moved, nor in the least damaged. The lightning passed, at the same time, down the flue of the back chamber, over the kitchen, and made its way out again at the gable end, within a few feet of the chamber grate. The shivered chimney-pipe belonged to this flue. The electric fluid passed also into the kitchen below, carrying down the soot from the flue, and exploding on the floor of the kitchen with a loud report. A woman had but just stepped on one side of the fire-place when this happened. At the moment before the report, she says she saw something like a ball of fire, and received a shock, which had the effect of stunning her for a moment; but she experienced no further injury. A girl and a child, who were in the parlour under the front room, were also unharmed. Indeed, no effects were produced by the lightning in this room, beyond the loosening of the screws of the gas-fittings in the centre.

DISINTEGRATION OF URINARY CALCULI BY THE ELECTRICAL DISCHARGE.

Dr. George Robinson, of the Newcastle-upon-Tyne College of Practical Science, in a communication to the Royal Society, thus details the experiments, by means of which he has almost effected the actual Disintegration of a Calculus in the Bladder of a Living Person, by the lateral disruptive force of the Electrical Discharge.

Two copper wires, 1-20th of an inch in diameter, were connected, one with the external, the other with the internal surface of a Leyden jar, having about 400 square inches of internal metallic coating. These copper wires were soldered to platinum wires half an inch long and 1-30th of an inch in diameter. Each wire was drawn through a *fine gutta percha* tube, and the tubes, having first been placed per-

:ly parallel, were warmed and gently pressed together so as to ume somewhat of the appearance of a flexible bougie; the platinum es projecting beyond the gutta percha to the extent of 1-8th of an h, and their free extremities being slightly everted and separated n each other by an interval of 1-10th of an inch. In experiment- , the united gutta percha tubes were grasped, and the projecting tinum points pressed against the surface of the calculus: the jar s then discharged by another person, and a series of such discharges is passed between the free extremities of the parallel platinum wires ile resting upon the surface of the stone.

With this simple arrangement, fragments a quarter of an inch long re broken from off flints immersed in water, and the same force s applied to urinary calculi with the following results:—

Exp. 1.—June 7th.—A piece of a large lithic acid calculus was placed in a lder, nearly filled with water, into which the gutta percha bougie containing wires was then introduced, and the neck of the bladder tied round the instru- it. The bladder with its contents being placed on a wet board, the project- platinum wires were then kept in contact with the surface of the calculus, l the jar discharged. On opening the bladder and examining the stône, it was nd to be broken into numerous fragments by the single discharge.

Exp. 2.—A small phosphatic calculus, very smooth and hard, was experimented on in a similar manner. The first five discharges produced no perceptible .ct; but the sixth split it into at least twenty fragments, and many of these, on ng slightly pressed between the finger and thumb, readily broke down.

Exp. 3.—A very large oxalate of lime or mulberry calculus with projecting ercles was similarly tested, and the first discharge produced a small cavity in surface to which the wires were applied, separating a considerable quantity of sand; but subsequent discharges did not act so efficiently on this very large ne.

Exp. 4.—On the following day, June 8th, the experiment was repeated in the sence of Messrs. Potter Rayne, and Furness, surgeons in Newcastle, and a all calculus, removed a few months since by the gentleman last mentioned m a young boy, was, after a few trials, split through the centre, one-half being uced to fragments, and the other exhibiting in its interior a dark-coloured :leus of lithic acid.

These Experiments appear to demonstrate the practicability of plying the lateral disruptive force of the electrical discharge to the integration of calculi in the bladder. There can be no difficulty bringing the end of a gutta percha catheter, conveying two copper res, in contact with the surface of a stone in the bladder; and a y simple mechanical contrivance will enable the extremities of the tinum wires to be protruded when the end of the catheter touches calculus. By employing two wires, one connected with the posi- e, the other with the negative, portion of the jar or machine, not ly is the intensity of the discharge increased, but the body is also vented from forming any part of the circuit, and the risk of injury reby materially diminished. The bladder used in the above- ntioned experiments was not at all injured; and on retaining a rtion of it between the platinum wires so that the discharge pass ough it, no perforation or other destructive effect took place. The tta percha tubes, having the projecting platinum wires, were ced in the mouth without being in contact with the lips, and a charge sent through the wires, but there was no perceptible shock. hen, however, the bladder containing the stone rested upon the nd, during the *act of disintegration*, a smart impulse was felt.

On the whole (says Dr. Robinson), I am of opinion that the electrical force applied in the manner indicated, will be found quite as efficient for the disintegration of calculi in the bladder as the more formidable analogous operation of lithotrity, occasionally practised. And, as regards simplicity and security, the electrical apparatus certainly appears preferable to the instruments used for crushing the stone by ordinary mechanical force.

CHEAP ELECTRIC LIGHT.

It is stated in *Chambers's Edinburgh Journal* for August, that the Electric Light has been used at Paris to illuminate the works of the Napoleon docks, which were carried on by night as well as by day; and the apparatus was so complete, that for four months the light has been steadily burning. Economy is not its least recommendation, for the cost per night has not been more than 38 francs, which, as 800 men were employed, gives 4½ centimes—less than a halfpenny per man.

Dr. Watson, of the Electric Power Light and Colour Company, in consequence of a suggestion by the Editor of the *Builder*, has applied this novel agency in lighting the works of the new bridge at Westminster, in conjunction with Chappuis's Reflector. The patentee has also contracted to light Chelsea New Bridge by the same means; and Mr. Whitmarsh, of Paris, has obtained the permission of the Emperor of the French to fix one of these Electric illuminations at the Rond Point, to light up the grand avenue of the Champs Elysées, during the forthcoming Exposition in that capital. —*Builder*, No. 623.

APPLICATION OF THE ELECTRIC LIGHT TO METALLURGIC PURPOSES.

M. Pichon proposes to smelt the ores of iron and other metals by means of the same arrangement as that employed to produce the Electric Light, and in this way do away with the necessity of employing the immense quantities of fuel which are now used for that purpose. His apparatus consists of a series of electro-magnets with revolving armatures, set in motion by a steam-engine, exactly on the plan employed by Messrs. Elkington and Mason to develop electric currents for plating and gilding. The poles of the battery thus formed consist of carbon prisms 3 metres long, (9 feet 10 inches,) with square bases, each side being 60 centimetres (about 2 feet), one end being cut in the form of a cone, 50 centimetres (nearly 1 foot 8 inches) long. The square end of this prism is set in a metallic armature furnished with a ring, to which the conductors are attached, and is held between the jaws of a kind of vice moving in a slide, by which the charcoal can be advanced as fast as it consumes. Each two of these charcoal prisms with its battery constitutes what M. Pichon calls *a system*. A number of these systems may be arranged one over the other, so as to produce a great zone of heat. Over the charcoal prisms is fixed a hopper from which the ore and flux fall through the arch of electric light where the reduction and fusion of the metal *take place;* an inclined plane conducts the ore and flux into the

hopper. Under the charcoal is placed a crucible like that of a high furnace, into which the slag and fused metal fall after the ore has been reduced, and where they arrange themselves according to their specific gravities, and from the bottom of which the metal may be tapped in the usual way. When necessary, a hearth may be put in connexion with the crucible, so as to maintain the temperature.

Another arrangement is to place the prisms in an inclined position, and make them hollow throughout their length; the hollow being made cylindrical, so as to form a tube 40 centimetres in diameter. The ore and flux are introduced into this tube, and pushed forward by a kind of piston, so as to issue at the point of the charcoal in the midst of the electric arch. When six or nine systems are employed, it is only necessary to have the two or three upper ones hollow. A constant stream of ore and flux can in this way be made to fall through the heated zone; for while the piston of one prism is driving forward a charge of ore through the tube, the opposite tube of the same system may be recharging.—*Journal of Industrial Progress*, No. 11.

DEPOSITION OF METALS BY ELECTRICITY.

M. GAUDIN thus describes his method of causing Depositions of all kinds of Metals upon any Metal whatever, by immersion in a liquid or by a current of Electricity. Hitherto the solutions employed in depositing one metal upon another by electrical agency have been made with one or more salts of the metal to be deposited; the strength of the solution being subsequently maintained by the gradual dissolution of *anodes* of the same metal placed in the bath. M. Gaudin proposes to form his precipitating bath without the use of any metallic salts, except those produced by the dissolution of the anode alone. For this purpose he makes a saturated solution of common salt, with the aid of heat, allows it to cool, filters it, and then adds 1-200th of its weight of oil of vitriol, allows it to repose for 24 hours, and then filters it again. Into the solution thus constituted an anode of the metal to be precipitated is plunged, and in two hours it will be ready to give a deposit of metal by connecting it with a battery. Thus, to produce a bath that will yield a deposition of silver by simple immersion, it is only necessary to dissolve part of a small piece of silver in it, to allow the remainder to lie in it, and in 24 hours the bath is ready. He considers such a bath to be adapted to the deposition of gold, silver, tin, copper, iron, zinc, platina, &c. There is nothing very new in this process: still, if it should be found to answer, it would be more economical than forming the solutions in the first instance with expensive salts.—*Armengaud's Publication Industrielle.*

FORMATION OF BRASS BY GALVANIC AGENCY.

COPPER is more electro-negative than zinc, and separates more easily from its solutions than a metal less negative. If then, in order *to obtain a deposit of brass* by galvanic means, we employ a solution *containing the two* component metals, copper and zinc, in the propor-

tions in which they would form brass, there will only be produced by the action of the battery a deposit of real copper; the zinc, more difficult of reduction, remains in solution. What must be done then to obtain a simultaneous precipitate of the two metals in the proportions required, is either to retard the precipitation of the copper, or to accelerate that of the zinc. This may be effected by forming the bath with a great excess of zinc and very little copper.

Dr. Heeren gives the following proportions as having perfectly succeeded:—

There are to be taken of	Sulphate of Copper	1 part.
	Warm water	4 „
And then	Sulphate of zinc	8 „
	Warm water	16 „
	Cyanide of potassium . . .	18 „
	Warm water	36 „

Each salt is dissolved in its prescribed quantity of water, and the solutions are then mixed; thereupon a precipitate is thrown down, which is either dissolved by agitation alone, or by the addition of a little cyanide of potassium; indeed it does not much matter if the solution be a little troubled. After the addition of 250 parts of distilled water, it is subjected to the action of two Bunsen elements charged with concentrated nitric acid mixed with 1-10th of oil of vitriol. The bath is to be heated to ebullition, and is introduced into a glass with a foot, in which the two electrodes are plunged. The object to be covered is suspended from the positive pole, whilst a plate of brass is attached to the negative pole. The two metallic pieces may be placed very near.

The deposit is rapidly formed if the bath be very hot; after a few minutes there is produced a layer of brass, when the thickness augments rapidly.

Deposits of brass have been obtained in this way on copper, zinc, brass, and Britannia metal; these metals being previously well pickled. Iron may, probably, also be coated in this way; but cast-iron is but ill adapted for this operation.—*Mittheilungen des Hannov. Gewerbevereins, through Bulletin de la Société d'Encouragement,* No. 16.—*Journal of Industrial Progress,* No. 12.

HYDRO-PNEUMATIC BATTERY.

Signor Agostino Carosio, a physician of Genoa, has invented what he calls a Hydro-Pneumatic Battery, which he proposes to use as a motive power. His apparatus consists of a gas battery on the principle of Grove's: that is, a number of voltaic elements in which oxygen and hydrogen gases, by their combination to form water, develop an electric current. This current is conducted into a series of cells containing acidulated water, which is rapidly decomposed; the evolved gases, oxygen and hydrogen, being kept separately, are collected in two reservoirs, where their accumulation gradually develops a pressure of several atmospheres. From these reservoirs the gases are introduced in the same manner as steam or sur-heated air into two cylinders with pistons, the one for the oxygen being only

half the size of that for the hydrogen. The gases having done their work, and expanded into the volume which they should have under the ordinary pressure of the atmosphere, their temperature being considerably reduced in consequence of this expansion, pass into two other reservoirs, where they regain their normal temperature by the contact of the air with the vessels. From the latter reservoirs, the gases then flow into the gas battery to supply the place of what are continually converted into water. We have accordingly a kind of perpetual motion, and certainly the nearest approach that has yet been made to the solution of that fond dream of imaginative inventors. Dr. Carosio has not, however, solved it; for there is a certain loss of power from the resistance to the passage of the electric current, in conducting wires, &c.; and this loss is compensated for by the addition of a few ordinary cells to decompose water enough to produce the supplementary gas required. Extraordinary results are anticipated from this invention: certainly, if it is at all successful, it would go far to revolutionize navigation by means of vessels propelled by power, and would be of the greatest importance to countries without coal. Connected with this invention is a fact which speaks well for the patriotism and rapidly growing enterprise of Italy. A society, called *Societa dell'invenzione Carosio,* has been formed for working the patents which Dr. Carosio has secured in different countries, with a capital of 100,000*l.*, 40,000*l.* of which are to be allocated to the inventor. This Society was founded in March, 1853, and the whole of the shares were subscribed for almost immediately, as a question of patriotism. A laboratory and a workshop were at once organised, and the services of Mr. Siemens, an English engineer (well known for his improvements in the electric telegraph and water metres), secured.*

CHESTER'S TELEGRAPH BATTERY.

THIS Battery, while it does away entirely with local action, employs the cheapest materials and most convenient arrangement of parts. Its cells are of strong glass, and insulated from the shelves. Its metals are amalgamated zinc and a platinized and peculiarly insulated plate, the result of much study and experiment. The plates are supported by metal clamps and thoroughly insulated wood. The construction is such as to secure perfectly against any cross-fire. The plates can be removed and cleaned separately, without stopping the working of the battery. The solution used to excite it is a dilute sulphuric acid. How free it is from local action may be inferred from the fact, that it has been in constant use for five months without being taken down, and that the zincs last such an unprecedented time. The relative cost of working these three batteries, without taking local action into consideration, supposing each equally free from local waste, is as follows; and the estimate is made up from

* From the *Monthly Journal of Industrial Progress* for 1854, No. 11. This new work, commenced with the past year, is ably edited by Professor Sullivan, of the *Museum of Irish Industry*. Dublin: W. B. Kelly.

actual experiment, by computing the destruction of battery material in each, necessary to accomplish a given equal amount of work—say the deposition of a pound of silver in the decomposition trough. To accomplish this,

Grove's consumes:—

1¼ pounds nitric acid, at 12c.	18 cents.
1¼ pounds zinc, at 10c.	12½ ,,
1 pound sulphuric acid	2 ,,
	32½

Daniell's consumes:—

4 pounds sulphate copper, at 11c.	44 cents.
1¼ pounds zinc	15 ,,
1 pound sulphuric acid	2 ,,
	61 cents.

The new battery:—

1¼ pounds zinc	15 cents.
3 pounds sulphuric acid.	6 ,,
	21 cents.

—*Franklin Journal.*

ELECTRIC TELEGRAPH INSULATOR.

DR. TURNBULL has called the attention of the Franklin Institute at Philadelphia to the great importance of proper Insulation of the metallic wires of the Electro-magnetic Telegraph. He exhibited two new forms of insulators. The first was a modification of the form designed by Mr. J. M. Batchelder, of Boston, but omitting the use of iron; being composed of flint, quartz, and feldspar, very compact, thoroughly vitrified on the surface, it was equal to the best forms of glass insulators, and much stronger; it is in the form of a cap with a ridge for the purpose of fastening the wire, and an inverted edge so as to divert the rain downward, and prevent it from entering the inside of the cap. He remarked, that even this form of insulator is defective, the moisture settles upon it, and this acts as a carrier of the electricity to the ground. A still further modification of this apparatus is desirable, so as to give the surface of the insulator a downy covering, to cause the moisture to remain in isolated drops upon it; this, Mr. Batchelder is endeavouring to accomplish. He has also produced a change by heat, &c., in the best electric substance known, namely, caoutchouc, so as to render it impervious to moisture, heat, and rapid decomposition, and fit it for insulating caps for the tops of posts.

The composition is of a dark colour, and in the form exhibited has a ringing noise when struck. Subjected to water at 212° it did not soften; strong sulphuric acid had no action upon it; even pure nitric acid did not destroy its elasticity, while it completely altered a piece of pure caoutchouc, converting it into a mass of brown colour, which, when pressed between the finger, fell to powder. The only change noticed was its colour, which was yellow instead of black. When placed in the flame of gas it burned with freedom, giving off scintilla-

tions as if combined with metallic oxide, leaving a polished surface; while ordinary caoutchouc liquid, when burned, produced a pyro-oil which stained the fingers; so that it has all the qualifications of a good insulating substance, being an electric not affected by a heat of 212°, not altered by acids, and not liable to decomposition.—*Mechanics' Magazine*, No. 1598.

ELECTRIC TELEGRAPH FOR THE SEAT OF THE WAR IN THE CRIMEA.

THE Electric Telegraph Company have supplied Government with a very complete and portable set of Electric Telegraph apparatus, adapted for use in the field, to accompany the munitions sent out to the East. It consists of two wagons, each containing a complete set of instruments, batteries, and telegraph apparatus: and a sufficient supply of insulated wire, to establish, at a moment's notice, a telegraphic communication to a distance of ten or twelve miles, either on land or under water. Each wagon is drawn by six horses, and accompanied by a staff of mounted officers and men; and Sappers and Miners educated for that duty at the Company's Central Station, at Lothbury.

The appliances for laying out the wire over irregular ground, and through marshes and rivers, are very ingenious; and the instruments are so thoroughly portable, that after being shifted from place to place, they can be fixed in working order in a few seconds. For communications by day and night, between distant points, such as the banks of a river, a distant outpost, or battery intrenchments, between vessels at sea, and especially between the fleet and the shore, this novel auxiliary will doubtless prove of the highest utility.

The mode of communication is briefly as follows:—The wire is deposited by a subsoil plough in the ground at a depth sufficient to protect it from ordinary casualties; the wire being coiled round a wheel revolving horizontally, attached to a carriage drawn in advance. The whole apparatus can be worked by the strength of eight men. Of course, this contrivance is available only for moderate distances. Twelve coils, each a mile in length, are neatly packed in the wagon, which also carries the plough, and the requisite tools.

PROGRESS OF ELECTRO-TELEGRAPHY.

Mediterranean.—The first portion of the Submarine Electric Cable for the Great Mediterranean and Indian line, has been completed and laid. This cable is the largest ever made; it is about 110 miles in length, and weighs about 800 tons. It contains six copper wires, or conductors, for the fluid to traverse, protected by a gutta percha covering secured in a hempen rope, and finally surrounded with 12 iron wires of number one gauge. The projector and originator, Mr. John Watkins Brett, profiting by experience, has allowed 20 miles for what is technically termed "slack" and "way," and for depth of the ocean. When coiled in the yard, the cable occupied about 75 feet, taking its convex side. The perpendicular height of the coil was about 5 feet, and the width of one side of the coil, from convex to concave, reached 24 feet. It is manufactured as follows:—

A yarn, well steeped in tar, is taken to form the heart of the cable as it was turned by the men. Around this the gutta percha tubes which protect the electric wires, six in number, are twisted by steam machinery, and as this coil passes away from this stage, it is firmly served by a second well-tarred yarn. This process is necessary to make the insulation complete, and to provent the gutta percha tubes from chafing. The cable being completed thus far, goes through a second operation: this time a coil of six iron wires is twisted round to form its outer protection: but the utmost nicety is required to regulate the pressure of the iron wires upon the gutta percha tubes. The whole coil having been passed through a preparation of tar, is then completed. The effect of the sea water upon tar, it would appear from a portion of the French electric cable, forms a concrete of great durability.

Italy.—A direct line between Piedmont and Switzerland, by Brissago, was opened on November 1st. Another line was opened, some time ago, between the two countries by St. Julian. Caserta, and the towns of Cancello Santa Maria, Capua, Mola, Terracina, Nola, Salerno and Avellino, are now connected with Naples by telegraphic lines, which are open to the public. A line is also in progress to connect Bologna and Ancona, a distance of 150 miles, and has already reached Rimini. It is believed it will be continued at Rome.

Switzerland.—Telegraph offices have been established at Délémont, in the Bernese Jura, and at Interlaken, the fashionable haunt of the English tourists in Switzerland. A star clock, constructed at Munich, has been placed at the Berne Observatory. Its pendulum touches every minute an electric wire, which puts it into instant communication with the Post-office.

Bank of England.—The electric telegraph operations have been completed, and a system of communication is effected between the various offices. The rooms of the Governor and Deputy-Governor are by this means placed in direct communication with every important department where business is transacted, and secresy of communication is obtained by the use of Dering's patent apparatus for this purpose, so that a message intended for one particular office cannot be read at any of the others.

Transatlantic.—Lieutenant Maury has satisfied himself of the practicability of establishing a submarine telegraphic communication between the coasts of Newfoundland and Ireland, and submits the grounds of his conviction to the Secretary of the Navy in a brief but very interesting statement. It reveals the extraordinary and hitherto, we believe, unsuspected facts, first, that there is an extended plateau lying between the shores of Newfoundland and Ireland, neither too deep nor too shallow, but apparently adapted by nature for the very purpose of supporting telegraphic wires; and secondly, that the surface of this plateau is beyond the reach of any oceanic or tidal currents, anchors, icebergs, or drifts of any kind, and the water on it withal so shallow, that wires may be readily lodged upon its bottom. The process by which these conclusions

were reached deserves to rank among the marvels of modern science. There is a Company fully organized for the construction of a line of telegraph from Newfoundland to New York, and a considerable fraction of the work is already completed. They had it in contemplation, when they obtained their charter from the legislature of Newfoundland, to continue their line to the coast of Ireland.—*New York Evening Post.*

United States and Canada.—In the States (says Mr. William Chambers), three kinds of telegraphs are employed—those of Morse, House, and Bain; the difference between them being mainly the method of indication. Unitedly, the various telegraphic systems pervade the entire region between the Atlantic and Mississippi, and from Nova Scotia and Canada to New Orleans. The number of miles of telegraph in the States is now about 20,000; and in Canada and other British possessions, from 2000 to 3000. The wires are carried along the sides of the railways, across fields and rivers, through forests, and in cities they may be seen crossing the streets and the tops of the houses. From New York, two lines proceed south to New Orleans; one by way of Philadelphia, Baltimore, Washington, and Charleston, making a length of 1966 miles; the other runs from Cleveland, on Lake Ontario, by Cincinnati and Nashville, being a length of 1200 miles. So small a price is charged, that there is a large amount of miscellaneous correspondence, besides market and stock intelligence. A message of ten words, for example, may be sent from Washington to St. Louis—a distance of 989 miles—for 1 dollar 20 cents. Under 200 miles, the charge is about a cent. per word. On some lines as many as 700 messages are sent in one day. So rapid is the transit, that the news brought to New York by a European steamer, at eight o'clock a.m., has been telegraphed, by way of Cincinnati, to New Orleans, and the effects there produced on the market returned to New York by eleven o'clock—being a circuit of nearly 4000 miles in three hours.

NEW EFFECT OF THE MAGNETIC TELEGRAPH.

THE various wires of telegraphs beginning to intersect so many sections of the United States, are said to have a decided effect upon electricity. Professor Olmstead, of Yale College, states, that as the storm comes up, and especially when over the wires, say fifty or a hundred miles distant, the lightning is attracted by the wires; which can be proved by any one remaining in a telegraph office for half an hour. About the time the storm in coming up, the wires are continually filled with electricity. It is the Professor's opinion, that we should never have heavy thunder showers, or hear of lightning striking, so long as we have telegraph wires spread over the earth.

USE OF THE ELECTRIC TELEGRAPH IN GEOGRAPHY.

AT a late meeting of the Belgian Academy of Sciences, M. Quetelet, the secretary, read an extract from the Report made by the British Astronomer Royal (Mr. Airy) on recent experiments to determine the difference of longitude between the observatories of

Greenwich and Brussels by the submarine electric telegraph. Three thousand signals were exchanged between the observatories, and compared with the local time of each as determined by the meridian passage of certain stars; and of the 3000 signals 1000 were selected as the most carefully made or the most satisfactory. The result, Mr. Airy says (and there is no higher authority), presents a degree of accuracy to which no previous determination of longitude can pretend. He thinks the probable error in distance cannot exceed one or two yards, and this upon a line about 190 miles in length! The problem consists in measuring with great precision the difference of time between an astronomical clock at Greenwich and one at Brussels. Now, this is only about 17 minutes, or 1020 seconds, and two yards in that case represent no more than the 180th part of a second; while we know that astronomers have no direct means of measuring a smaller fraction of time than the tenth of a second. How then is a fraction 18 times less than the 10th of a second ascertained? The secret lies in the power which the electric telegraph gives of repeating an observation any number of times, and with extreme facility. In the present case, 3000 observations were taken, of which 1000 of the most perfect were selected; and from the mean of these a result is deduced possessing a degree of minute precision not attainable by any other method. Where the telegraph exists, longitudes, hitherto the loosest of all measures on the earth's surface, may be rendered the most exact. Few gentlemen who have had their estates surveyed know the length or breadth of one of their farms as correctly as the distance between Greenwich and Brussels is now known.

NEW SYSTEM OF ELECTRIC SIGNALS.

SOME experiments have been made with a New System of Electric Signals at the Paris station of the Northern Railway. An apparatus having the words *train* and *tout est bien* is placed at each station. An indicator or hand is placed in this apparatus, and is attracted by the magnetic power on the inside, to the one or the other direction, according to the electric current. On the outside of each station is placed a pedal, with a spring adjusted in such a manner that each wheel of the train presses on the spring; thus establishing a contact which gives a movement of the pile to the apparatus, and produces the following effect:—1st. A ring of a bell at the next station announces that the train is advancing, by which means the *employés* prepare for its arrival; 2ndly, the indication to the preceding station having just signalised *la voie est libre*, it allows the announced train to advance, if, on the contrary, the hand points towards the word train. In drawing the handle of the apparatus at its station, it communicates to the indication fixed on the locomotive the signal *arrêtez:* but as soon as the indicator at the station shows *la voie est libre*, by reversing the handle above-mentioned, the engine-driver receives the signal *tout est bien*, and he then knows that he may advance with security. By a very simple combination, when the *signal arrêtez* is given, the engine-driver can immediately shut off his steam, so that all accident may be prevented.

Chemical Science.

BAKERIAN LECTURE, ON OSMOTIC FORCE.—BY PROFESSOR GRAHAM.

THIS name was applied to the power by which liquids are impelled through moist membrane and other porous septa in experiments of endosmose and exosmose. It was shown that with a solution of salt on one side of the porous septum and pure water on the other side, (the condition of the osmometer of Dutrochet when filled with a saline solution and immersed in water,) the passage of the salt outward is entirely by diffusion, and that a thin membrane does not sensibly impede that molecular process. The movement is confined to the liquid salt particles, and does not influence the water holding them in solution, which is entirely passive: it requires no further explanation. The flow of water inwards, on the other hand, affects sensible masses of fluid, and is the only one of the movements which can be correctly described as a current. It is osmose, and the work of the osmotic force to be discussed. As diffusion is always a double movement—while salt diffuses out, a certain quantity of water necessarily diffuses in at the same time, in exchange—diffusibility might be imagined to be the osmotic force. But the water introduced into the osmometer in this way has always a definite relation to the quantity of salt which escapes, and can scarcely rise in any case above four or six times the weight of salt; while the water entering the osmometer often exceeds the salt leaving it at least one hundred times; diffusion, therefore, is quite insufficient to account for the water current. The theory which refers osmose to capillarity appears to have no better foundation. The great inequality of ascension assumed among aqueous fluids is found not to exist when their capillarity is correctly observed, and many of the saline solutions which give rise to the highest osmose are indistinguishable in ascension from pure water itself. Two series of experiments on osmose were described:—the first series made with the use of porous mineral septa, and the second series with animal membrane. The earthenware osmometer consisted of the porous cylinder employed in voltaic batteries, about five inches in depth, surmounted by an open glass tube 0·6 inch in diameter, attached to the mouth of the cylinder by means of a cup of gutta percha. In conducting an experiment, the cylinder was filled with any saline solution to the base of the glass tube, and immediately placed in a large jar of distilled water; and as the fluid within the instrument rose in the tube, during the experiment, water was added to the jar so as to prevent inequality of hydrostatic pressure. The rise (or fall) of liquid in the tube was highly uniform, as observed from hour to hour, and the experiment was generally terminated in five hours. From experiments made on solutions of every variety of soluble substances, it appeared that the rise or osmose is quite insignificant with neutral organic substances in general, such as sugar, alcohol, urea, tannin, &c.; so also with

neutral salts of the earths and ordinary metals, and with chloride of sodium and potassium, nitrates of potash and soda, and chloride of mercury. A more sensible but still very moderate osmose is exhibited by hydrochloric, nitric, acetic, sulphurous, citric and tartaric acids. These are surpassed by the stronger mineral acids, such as sulphuric and phosphoric acid, and sulphate of potash; which are again exceeded by salts of potash and soda, possessing either a decided acid or alkaline reaction, such as binoxalate of potash, phosphate of soda, and carbonates of potash and soda.

The highly osmotic substances were also found to act with most advantage in small proportions, producing in general the largest osmose in the proportion of one-quarter per cent. of salt dissolved. Osmose is, indeed, eminently the phenomenon of weak solutions. The same substances are likewise always chemically active bodies, and possess affinities which enable them to act upon the material of the earthenware septum. Lime and alumina were accordingly always found in solution after osmose, and the corrosion of the septum appeared to be a necessary condition of the flow. Septa of other materials, such as pure carbonate of lime, gypsum, compressed charcoal, and tanned sole-leather, although not deficient in porosity, gave no osmose, apparently because they are not acted upon chemically by the saline solutions. Capillarity alone was manifestly insufficient to produce the liquid movement, while the *vis motrix* appeared to be chemical action. The electrical endosmose of Porrett, as lately defined with great clearness by Weidemann, was believed to indicate the possession of a peculiar chemical constitution by water, while liquid, or at least the capacity to assume that constitution when water is polarized and acting chemically upon other substances. A large but variable number of atoms of water are associated together to form a liquid molecule of water, of which an individual atom of oxygen stands apart, forming a negative or chlorous radical; while the whole remaining atoms together are constituted into a positive or basylous radical; which last will contain an unbalanced equivalent of hydrogen giving the molecule basicity, as in the great proportion of organic radicals. Now it is this voluminous basylous radical which travels in the electrical decomposition of pure water, and resolves itself into hydrogen gas and water at the negative pole, causing the accumulation of water observed there; while the oxygen alone proceeds in the opposite direction to the positive pole. Attention was called to the fact, that acids and alkalies, when in solution, are chemically combined with much water of hydration; sulphuric acid, for instance, evolving heat when the fiftieth equivalent of water is added to it. In the combination of such bodies, the disposal of the water is generally overlooked. Osmose was considered as depending upon such secondary results of combination; that is, upon the large number of voluminous proportions of the water molecules involved in such combinations. The porous septum is the means of bringing out and rendering visible, both in electrical and ordinary osmose, this liquid movement attending chemical combinations and decompositions. *Although the nature* and *modus* operandi of the chemical action

producing osmose remains still very obscure, considerable light is thrown upon it in the application of septa of animal membrane. Ox bladder was found to acquire greatly increased activity, and also to act with much greater regularity, when first divested of its outer muscular coat. Cotton calico also, impregnated with liquid albumen, and afterwards exposed to heat so as to coagulate that substance, was sufficiently impervious, and formed an excellent septum, resembling membrane in every respect. The osmometer was of the usual bulb-form, but the membrane was supported by a plate of perforated zinc, and the instrument provided with a tube of considerable diameter. The diameter of the tube being one-tenth of that of the mouth of the bulb or disc of membrane exposed to the fluids, a rise of liquid in the tube amounting to 100 millimètres indicated that as much water had permeated the membrane and entered the osmometer as would cover the whole surface of the membrane to a depth of one millimètre, or one twenty-fifth part of an inch. Such, millimètre divisions of the tube become degrees of osmose, which are of the same value in all instruments.

Osmose in membrane presented many points of similarity to that in earthenware. The membrane is constantly undergoing decomposition, and its osmotic action is inexhaustible. Further, salts and other substances capable of determining a large osmose are all chemically active substances, while the great mass of neutral monobasic salts of the metals, such as chloride of sodium, possess only a low degree of action, or are wholly inert. The active substances are also relatively most efficient in small proportions. When a solution of the proper kind is used, the osmose or passage of fluid proceeds with a velocity wholly unprecedented in such experiments. The rise of liquid in the tube with a solution containing one-tenth per cent. of carbonate of potash in the osmometer, was 167 degrees or millimètres, and with one per cent. of the same salt, 206 degrees in five hours. With another membrane and stronger solution, the rise was 863 millimètres, or upwards of 30 inches in the same time; as much water therefore was impelled through the membrane as would cover its whole surface to the depth of 8·6 millimètres, or one-third of an inch. The chemical action must be different on the substance of the membrane at its inner and outer surfaces to induce osmose; and according to the hypothetic view which accords best with the phenomenon, the action on the two sides is not unequal in degree only, but also different in kind. It appears as an alkaline action on the albuminous substance of the membrane, at the inner surface, and as an acid action on the albumen at the outer surface. The most general empirical conclusion that can be drawn is, that the water always accumulates on the alkaline or basic side of the membrane. Hence, with an alkaline salt, such as carbonate or phosphate of soda, in the osmometer and water outside, the flow is inwards; but with an acid in the osmometer, on the contrary, the flow is outwards, or there is negative osmose, the liquid then falling in the tube. In the last case, the water outside is basic when compared with the acid within, and the flow is therefore still towards the base. The

chloride of sodium, chloride of barium, chloride of magnesiu similar neutral salts, are wholly indifferent, or appear only to a subordinate manner to some other active acid or basic substa which last may be present in the solution or membrane in th minute quantity. Salts which admit of dividing into a basic and free acid exhibit an osmotic activity of the highest order. are the acetate and various other salts of alumina, iron and chro the protochloride of iron, chloride of copper, nitrate of lead, & acid travels outwards by diffusion, superinducing a basic condi the inner surface of the membrane and an acid condition of th surface, the favourable condition of a high positive osmose. The salts of potash and soda again, such as the sulphate and tart potash, although strictly neutral in properties, begin to ex positive osmose, in consequence, it may be presumed, of thei lution into an acid supersalt and free alkaline base. The fol table exhibits the osmose of substances of all classes:—

Osmose of 1 per cent. Solutions in Membrane.

Oxalic Acid	— 148 degrees.
Hydrochloric Acid	— 92
Terchloride of Gold	— 54
Bichloride of Tin	— 46
Bichloride of Platinum	— 30
Chloride of Magnesium	— 3
Chloride of Sodium	+ 2
Chloride of Potassium	18
Nitrate of Soda	2
Nitrate of Silver	34
Sulphate of Potash	21 to 60
Sulphate of Magnesia	14
Chloride of Calcium	20
Chloride of Barium	21
Chloride of Strontium	26
Chloride of Cobalt	26
Chloride of Manganese	34
Chloride of Zinc	54
Chloride of Nickel	88
Nitrate of Lead	125 to 211
Nitrate of Cadmium	137
Nitrate of Uranium	234 to 458
Nitrate of Copper	204
Chloride of Copper	351
Protochloride of Tin	289
Protochloride of Iron	435
Chloride of Mercury	121
Protonitrate of Mercury	356
Pernitrate of Mercury	476
Acetate of Sesquioxide of Iron	194
Acetate of Alumina	280 to 393
Chloride of Aluminum	540
Phosphate of Soda	311
Carbonate of Potash	439

It may appear to some, that the chemical character wh been assigned to osmose takes away from the physiological i of the subject, in so far as the decomposition of the membra appear to be incompatible with vital conditions, and that movements must therefore be confined to dead matter; bu apprehensions are, it is believed, groundless, or at all events

ture. All parts of living structures are allowed to be in a state of incessant change of decomposition and renewal. The decomposition occurring in a living membrane while effecting osmotic propulsion may possibly, therefore, be of a reparable kind. In other respects, chemical osmose appears to be an agency particularly adapted to take part in the animal economy. It is seen that osmose is peculiarly excited by dilute saline solutions, such as the animal juices really are, and that the alkaline or acid property which these juices always possess, is another most favourable condition for their action on membrane. The natural excitation of osmose in the substance of the membranes or cell-walls dividing such solutions, seems therefore almost inevitable. In osmose there is, further, a remarkably direct substitution of one of the great forces of nature by its equivalent in another force—the conversion, as it may be said, of chemical affinity into mechanical power. Now what is more wanted in the theory of animal functions than a mechanism for obtaining motive power from chemical decomposition as it occurs in the tissues? In minute microscopic cells the osmotic movements being entirely dependent upon extent of surface, may attain the highest conceivable velocity. May it not be hoped therefore to find, in the osmotic injection of fluids, the deficient link which certainly intervenes between muscular movement and chemical decomposition?

NEW ELECTRICAL BATTERY.

MR. W. SYMONS has described to the British Association, a new Electrical Battery, composed of a series of plates made of a mixture of gutta percha, bees'-wax, and shellac. The details of this battery will be found in the *Pharmaceutical Journal* for July, 1854.

CONTRIBUTION TOWARDS THE HISTORY OF PARAFFINE. BY BARON REICHENBACH.*

NEARLY a quarter of a century has now elapsed since I exhibited the first specimen of Paraffine to the German Association of Naturalists, at Hamburgh, in 1830, and described the mode of preparing this substance in Schweigger's *Journal of Chemistry*. With the exception of some analyses by Ettling, Lewy, and others, very little has been communicated regarding this body since that period. The very valuable properties of paraffine, the power with which it resists the action of concentrated acids and alkalies, and even of potassium at a boiling temperature, the brilliant whiteness of its flame, which deposits no soot, its beautiful translucency and its lubricating quality, recommend this substance for various technical applications; and I have myself called attention to this fact from its first discovery, without being able, however, to arrive at any satisfactory results in its industrial application. The difficulty which presented itself, was the small quantity which the dry distillation of wood furnishes of this substance. I subsequently showed that paraffine might be obtained from vegetable oils, from animal substances, and likewise from pit-

* From the *Journal für praktische Chemie*, by Otto Linné Erdmann and Gustav Werther, No. 17, October, 1854; *Philosophical Magazine*, No. 54.

coal; but from all these substances so minute a quantity was obtained that its production for manufacturing purposes was neither remunerative nor inviting. Thus paraffine remained up to this period an interesting curiosity, unknown except in the collection of scientific chemists.

I now hear that in England, which is essentially the country of useful applications, a manufactory of paraffine upon an extended scale has been carried on by Mr. Young, since 1850. This very able chemist has succeeded in finding a method which yields comparatively large quantities of paraffine. Mr. Young obtains 13 pounds from a ton of cannel coal. This discovery renders the preparation of paraffine a lucrative branch of industry, especially since, in addition to the production of paraffine, a large quantity, about 36 gallons, of a lubricating oil is obtained which is saturated with paraffine; and which is said to surpass all other fatty substances as an antifrictional, and to have been already so generally adopted, that Young's works now supply weekly as much as 8000 gallons to the market. The most evident proof of the advantages offered by paraffine, is the rivalry which has already ensued in its production, and is well illustrated by an action at law, which some of the later competitors of Mr. Young have brought against him with the view of upsetting his patents, by attempting to prove that the discovery was not new, and was, in fact, not capable of being patented. It is true that the discovery of paraffine is my own, and I have announced it. To Mr. Young, however, belongs the merit of a second discovery, the merit of having elaborated a method which furnishes a comparatively *large* quantity of this substance, and which is sufficiently remunerative to the manufacturer; a result which I had vainly endeavoured to realize. I hope that Mr. Young will succeed in convincing the legal authorities of the priority of his practical discovery, which was not part of any purely scientific investigation, and which I cannot claim in any way. May he enjoy the fruits of his invention and of his industry, which he deserves, and to which no other person has a right!

CONCENTRATION OF ALCOHOL IN SÖMMERING'S EXPERIMENTS.

PROFESSOR GRAHAM, in a communication to the British Association, states that when an open vessel is filled with a mixture of alcohol and water and exposed to the air, the alcohol goes off first and leaves the water; but if, as in Sömmering's Experiments, a bladder be completely filled with dilute alcohol, the liquid will decrease in bulk, and the water pass through the membrane, leaving a much larger per centage of alcohol in the bladder. Dry membrane does not exhibit this phenomenon; for a jar, the mouth of which is covered with dry bladder, allows the alcohol to escape first. The author believes that liquids diffuse mechanically, by a kind of repulsive force of the same nature as that exhibited by gases. When common salt is added to water in a jar, membrane tied over it, and immersed in a vessel containing pure water, diffusion takes place in quantity which has a relation to the per centage of salt dissolved. Alcohol, however, exhibits an anomaly in this respect; for the quantity of alcohol which diffused

itself through the membrane, when 5 per cent. of alcohol was present in the liquid, was not increased when the per centage of alcohol was 10, 15, or 20. The phenomenon indicates a sifting or separating power to reside in membrane, and introduces a third element, in addition to diffusion and osmose, into the discussion of the permeability of membranous septa. The author believes that Sömmering's experiment was an instance of arrested diffusion where more than 5 per cent. of alcohol was present. The action has some resemblance to the separating and secreting power of cells in the living organism, and may prove of great physiological interest, particularly if the action should be found to extend to albumen and other organic substances.

Prof. Faraday considered the latter part of the paper exceedingly important, and expressed a wish that Prof. Graham would give his reasons for believing that liquids diffused owing to a repulsion between the liquid particles. Might not the attraction of the surrounding medium be wholly or partly the cause? In answer to this Prof. Graham stated that the phenomena characteristic of gaseous diffusion might be explained by an attractive as well as a repulsive force. In the diffusion of liquids, the same analogies were observed, as also the same intensity of action. From a bottle containing solution of alum, the sulphate of potash goes off first, and sulphate of alumina remains. Again, sulphurous acid and chloride of sodium may be boiled together and no hydrochloric acid is given off; but mix them in the diffusion vial, and hydrochloric acid is given off, whilst sulphite of soda remains. Experiments on this subject are being accumulated by the author, and he sees every reason to consider that since gaseous diffusion can be most clearly explained by the repulsive view, liquid diffusion, so analogous to it, should be likewise expressed.

ALCOHOL IN WINES.

Dr. Bence Jones, in a communication to the Royal Society, "On the Acidity, Sweetness, and Strength of Wine, Beer, and Spirits," states that he has determined, by means of the alcoholometer of M. Geisler, of Bonn, the strength of different samples of—

Port	varied from	20·7	per cent. to	23·2	per cent. by measure.
Sherry	,,	15·4	,,	24·7	,,
Madeira	,,	19·0	,,	19·7	,,
Marsala	,,	19·9	,,	21·1	,,
Claret	,,	9·1	,,	11·1	,,
Burgundy	,,	10·1	,,	13·2	,,
Rhine wine	,,	9·5	,,	13·0	,,
Moselle	,,	8·7	,,	9·4	,,
Champagne	,,	14·1	,,	14·8	,,
Brandy	,,	50·4	,,	53·8	,,
Rum	,,	72·0	,,	77·1	,,
Geneva	,,	49·4			,,
Whisky	,,	59·3			,,
Cider	,,	5·4	,,	7·5	,,
Bitter ale	,,	6·6	,,	12·3	,,
Porter	,,	6·5	,,	7·0	,,
Stout	,,	6·5	,,	7·9	,,

The Burgundy and Claret have less alcohol than was found by Mr. *Brande forty years* ago in the wines he examined. The Sherry is

now stronger; the Port is not so strong; the Marsala is weaker; the Rhine wine is the same strength; the Brandy is as strong as formerly; the Rum is nearly half as strong again; the Porter is stronger; and the Stout rather stronger than formerly.

NEW PROCESS OF ALKALIMETRY.

DR. ASTLEY PASTON PRICE remarks, the primary difficulty to be overcome is the entire expulsion of carbonic acid. Having prepared the standard solutions of a desired strength, the determination of an alkali or of an alkaline carbonate, may be thus effected:—10 grains of an alkaline carbonate, carbonate of soda for example, after having been placed in a flask, a solution of oxalic acid corresponding to 10 grains of pure carbonate of soda is added; the solution is then boiled until the expulsion of carbonic acid be effected, when the solution is diluted with distilled water; and after the addition of a few drops of a solution of litmus, the excess of oxalic acid is determined by a standard solution of ammonia. The excess of oxalic acid remaining will, of course, indicate the impurities present, or the absence of alkali, which, by deduction from the quantity originally taken, will give the amount of available alkali.

Care must be taken that the solution be only tinted with litmus, and not too deeply coloured; as the more feeble the coloration within certain limits, the more easily detected is the change of tint produced by an excess of alkali or of acid.

Dr. Price has found it necessary to employ distilled water for diluting the solutions, failing, as he has done, to obtain accurate results with other water, owing to the presence of carbonic acid.—*Abridged from the Chemical Gazette.*

CONSTANT ACTION BLOW-PIPE.

S. DE LUCA has proposed to attach a vulcanized india-rubber bag to the tubular stem of a common Blow-pipe, and to fasten the cylindrical end with its nozzle to the other end of the bag, the latter thus constituting a part of the stem of the blow-pipe. The end of the tubular stem which opens into the bag is closed by a valve which opens inwards. If air be blown through such a blow-pipe, the elastic bag will be inflated; and as the compressed air cannot return through the valve, it will flow through the nozzle, and maintain the blast of air constant, the bag requiring only to be filled from time to time. Such an instrument does away with the inconvenience of maintaining a constant blast by the mouth, which is very tiresome, and, to many persons, injurious, especially when it is necessary to blow for a considerable time. This form recommends itself as much to jewellers as to chemists.—*L'Institut,* No. 1054.

BRIET'S GAZOGENE APPARATUS.

MM. MONDOLLOT, of Paris, successors of M. Briet, have made an improvement in the Gazogene Apparatus which bears the name of the latter, by surrounding the upper vessel with an outer one or *jacket, fitted* with a cover. The space between the case and the

enclosed vessel may be filled with ice or with cold water, into which refrigerent mixtures may be put. In this a much more agreeable summer beverage may be prepared than with the original apparatus. —*Le Génie Industriel.*

APPLICATION OF GAS TO ASSAY FURNACES.

MM. PELIGOT and LEVOL have established in the Paris Mint furnaces for assaying gold, in which common coal gas is employed as the source of heat with considerable advantage.

EFFECT OF COLOURED LIGHT ON GERMINATION.

To determine the commercial value of any seeds, one hundred of them are placed in a pot in a stove-house for the purpose of quickening the process of Germination. If all the seeds germinate, the seeds obtain the highest value in the market. If only eighty germinate, the seed loses twenty per cent. in value. This process ordinarily occupies from twelve to fifteen days; but Mr. Lawson has found that by using *blue* glass he is enabled to determine the value of the seed in two or three days; and this is a matter of such commercial importance to him that it is quite equal to a gift of 500*l*. a-year.—*Proceedings of the Royal Polytechnic Society.*

INFLUENCE OF THE SOLAR RADIATIONS ON THE VITAL POWERS OF PLANTS GROWING UNDER DIFFERENT ATMOSPHERIC CONDITIONS.

MR. J. H. GLADSTONE has read to the British Association the second Report given by the author, and commenced by describing accurately what portions of the prismatic spectrum were cut off by the various coloured glasses employed in his experiments. A series of observations followed on hyacinths grown under very varied influences of light, and solar heat, and chemical agency. Among the results may be mentioned the power of the yellow ray to diminish the growth of rootlets, and the absorption of water; the power of the red ray to hinder the proper development of the plant; and the effect of total darkness in causing a rapid and abundant growth of thin rootlets, in preventing the formation of the green colouring matter, but not of that of the blue power, nor of the other constituents of a healthy plant. A series of experiments on germination was then detailed. Wheat and peas had been grown without soil under large colourless, blue, red, yellow, obscured colourless, and obscured yellow glasses, and in perfect darkness. The effects resulting from these varied conditions were very marked; and the description of them occupies a considerable space in the Report. The two plants experimented on—being chosen from the two great botanical divisions—exhibited a wide diversity, sometimes amounting to a direct opposition, in their manner of being affected by the same solar ray; but in the case of both the plants, under the circumstances of the experiment, the following effects were observed:—The cutting off of the chemical ray facilitates the process of germination, and that both in reference to the protrusion of the radicles, and the evolution of the plume: the stem grows

unnaturally tall, and there is a poor development of leaves in darkness, becoming more manifest as the darkness is more complete; and the yellow ray exerts a repellant influence on the roots, giving the wheat a downward and the pea-roots a lateral impulse. A few experiments on the germination of other seeds were then narrated; and the Report concluded with an account of experiments on the germination of wheat and peas in oxygen, hydrogen, and carbonic acid gases, as well as in ordinary atmospheric air, and in air from which carbonic acid was at all times certain to be removed. The results confirmed former observations on the necessity of oxygen.

Professor Miller, in thanking the author for his valuable researches, made some remarks on the interesting results that the investigation had brought to light; and drew especial attention to the remarkable fact stated in the paper, that the blue rays retarded the action of germination at first, although they probably accelerated the growth of the plant afterwards,—the act of germination being attended with the absorption of oxygen, but the process of development being, on the contrary, attended with the extrication of this gas. Professor Anderson remarked, that a similar difference in the rate of growth of the leguminous plants and grasses to that described by Mr. Gladstone had been observed when they were manured with the same material. Nitrate of soda, which was found to be an excellent fertilizer for grasses, had comparatively little influence upon leguminous plants.—*Athenæum*, No. 1405.

LEAD IN HYDROCHLORIC AND NITRIC ACIDS.

DR. S. MACADAM, in a communication to the British Association, states that in the course of some analyses made with the view of determining, if possible, the presence of lead in animal organisms, the author saw reason to suspect that the Acids employed by him might contain Lead. On testing these—which were the purest to be purchased from the manufacturers—small but very distinct indications of lead were obtained. In commercial or impure specimens of hydrochloric and nitric acids, the lead is much more abundant. The importance of such a discovery in reference to searching for metallic poisons in organized tissues is so great, that the author cautions analytical chemists against the use of the acids for such purposes, without previously testing them for lead.

After the reading of this paper, it was stated that a considerable portion of lead had been detected in snuff and curry; and instances were named of persons who had been sufferers from this poisonous substance being introduced into the system by snuff-taking.

VOLATILE BASES OF BITUMINOUS SHALE.

MR. C. GREVILLE WILLIAMS has read to the Chemical Society, a paper "On the Volatile Bases produced by Destructive Distillation of the Bituminous Shale of Dorsetshire." He showed that although the organic matter in the shale was in a semi-fossilized state, the alkaloids picoline and lutidine were present in considerable quantity, accompanied by a new base which he calls vertidine, and another not yet named. He likewise described two new and very singular bases,

carmidine and methyle-lutidine; the latter remarkable for the magnificent purple which its solution soon acquires. He also traced out at some length the relations existing between the isomeric groups of bases represented by aniline on the one hand, and pyridine on the other.

PURIFICATION OF GRAPHITE FOR LEAD PENCILS.

RUNGE proposes to purify poor Graphite for Pencils, by digesting, for thirty-six hours, the finely powdered mineral with about double its weight of concentrated sulphuric acid; then diluting the acid with water, and washing the powder free from acid. Graphite thus powdered is very much cheaper than the ordinary English, and is quite as pure as the best Borrowdale black-lead. The decanted sulphuric acid contains iron, sulphate of alumina, &c.; the latter may be separated when large quantities of graphite are operated upon. Runge also proposes to add a little lamp-black with the graphite, in order that the lines made by the pencils may have a deeper shade of black. Probably, certain kinds of manganese may be used for the same purpose.—*La Technologiste; Dublin Journal of Industrial Progress*, No. 1.

NEW METALLIC ALLOY.

M. DELANDE, of Paris, has presented an invention, which consists in certain processes for producing a New Metallic Alloy, similar to silver in appearance, and intended to supersede it in various applications. Tin forms the base of the composition; and, to prepare it, the inventor calcines it two or three times with saltpetre, and reduces the calcined part to powder, which is melted down in a crucible. When in a fluid state, it is purified by being mixed with charcoal powder, the clear part being drawn off into another crucible ready for use.—*Mining Journal.*

CHEMISTRY OF OPIUM.

DR. ANDERSON has read to the British Association a paper "On the Constitution of Meconine and Papaverine, and their Relations to the other Constituents of Opium." The author commenced by referring to the opinion often expressed by chemists, that where several well-marked crystalline compounds are met with in the same plant, some definite chemical relation must exist between them. But even in those cases—as, for instance, in that of quinine and cinchonine, where the formulæ of the substances are very simply related—the conversion of one into the other has not been successful. In the course of the author's investigation of the opium compounds, he had obtained a product of decomposition of narcotine, which he called opianyl. The result of the experiments now detailed showed that this substance is identical with the meconine which Combe found naturally existing in opium. The author having thus made the first step towards the simplification of the complex chemistry of opium, concluded by pointing out the relations subsisting among its other

constituents; and expressed the opinion that these could not be fortuitous, but pointed to the possibility of further simplifications.

CHEMICO-PHYSIOLOGICAL ACTION OF COFFEE.

DR. JULIUS LEHMANN gives the following as the results of his experiments upon the Action of Coffee as an article of diet:—

1. The use of a decoction of coffee produces two effects upon the body which are very difficult to unite—it causes the assimilation of the food to take place slower, and produces a greater activity of the nervous and circulating systems.

2. It enlivens the activity of the mind, a general feeling of well-being and elevation of spirits being produced by the mutual modification of the special actions of the empyreumatic oil and of the caffeine.

3. The retardation of the assimilation is chiefly owing to the action of the empyreumatic oil; but the caffeine also acts similarly when large quantities of it are taken.

4. Increased action of the heart, trembling, suppression of urine, headache, a peculiar intoxicated state and delirium, are the results of the action of the caffeine.

5. Increased function of the perspiratory glands and kidneys, acceleration of the peristaltic motion, elevation of the activity of the understanding, congestions, restlessness, and loss of sleep, are produced by the empyreumatic oil.—*Liebig's Annalen*, lxxxvii.

CARBAZOTIC ACID.

PROFESSOR C. CALVERT has read to the British Association a paper "On the Physiological Properties of Carbazotic Acid." The author stated that Dr. Bell, Physician to the Royal Infirmary, Manchester, had cured several cases of intermittent fever with this acid. He also said, that he should be very happy to furnish any physician with a small quantity of this substance, so that its real medical value might be ascertained. After describing the process by which pure carbazotic could be procured from carbolic acid, he impressed upon the meeting the value of the pure acid as a yellow dye for silk.

Mr. Warrington observed that carbazotic acid was first employed in silk-dyeing at Lyons—that in 1851 its price at Paris, where it was manufactured, was 10s. per lb.; and that if the grass tree or black bay gum (which could be imported into this country from Australia for 14s. per cwt.), were employed, and treated with nitric acid (a process originally suggested by Dr. Stenhouse) he believed that it might be prepared for a shilling per lb.

NEW DERIVATIVES OF CHLOROFORM. BY PROFESSOR WILLIAMSON.

ACCORDING to the results of recent researches in the constitution of salts, and the methods thence introduced of explaining chemical reactions, it is equally correct to represent such a reaction as that of hydrochloric acid on hydrate of potash, as consisting in an exchange of hydrogen of the one for potassium of the other, or of chlorine in one for peroxide of hydrogen in the other. In Mr. Kay's researches,

this notion has obtained very striking illustration; for he has obtained a peculiar body in which the chlorine of chloroform is replaced by peroxide of æthyle by the action of chloroform on three atoms of æthylate of sodium, which product may be equally well conceived to be a body in which the hydrogen of three atoms of alcohol is replaced by the tribasic radical of chloroform.—See the outline of the Researches in the *Proceedings of the Royal Society*, June 15, 1854.

ARTIFICIAL SEA-WATER.

DR. G. WILSON has read to the British Association a paper "On the Artificial Preparation of Sea-Water for Marine Vivaria." This contribution was a criticism on a communication made by Mr. Gosse, and contained in the *Annals of Natural History*. Guiding himself by Schneitzer's analysis, Gosse employed chloride of sodium, sulphate of magnesia, chloride of magnesium, and chloride of potassium. Into a mixed aqueous solution of these salts, Gosse introduced various species of marine plants and animals; and for six weeks they throve and flourished. Dr. Wilson considers, however, that the less abundant, but still essential, constituents of sea-water—such as carbonate of lime, sulphate of lime, phosphate of lime, fluoride of calcium, silica, iodine, and bromine—should not be absent, as these latter substances are found in marine plants and animals; it is therefore plainly evident that the medium in which they live ought to contain the same substances. It is, of course, quite possible that in a single aquarium, the death of a certain portion of the animals might furnish calcareous salts, &c. for the growth and preservation of their survivors; and in like manner the death of a given number of plants might liberate iodides, bromides, &c., for the remainder. But this destruction of part of the occupants of the aquarium for the preservation of the other part might be easily avoided, as calcareous phosphates, carbonates, and fluorides, occur together in shells, corals, and many limestones. The arrangement of fragments of such calcareous bodies at the bottom of the aquarium would supply some of the missing ingredients; whilst pieces of trap rock and a few grains of an iodide and bromide would afford the remainder.

Loch-NESS WATER—ACTION UPON LEAD.

A CHEMICAL and medical Report has been made on the water of Loch-Katrine, from which ample source it was proposed to supply the city of Glasgow. The first Report, by Dr. Thomas Anderson and Mr. D. Campbell, states that they examined the waters of Loch-Ness, in all respects similar to those of Loch-Katrine, and like it they act energetically upon lead when exposed. But in Inverness, not a trace of lead could be detected in water taken from pipes and cisterns which had been in use from three months to twenty years, although the same water acted powerfully on fresh surfaces of lead; no injurious effects upon the health of the inhabitants, arising from lead poison, could be traced, with the assistance of an experienced medical gentleman of the place. Professor Graham and Professor Hoffman, of London, give similar evidence:—"We have also had

occasion to examine the water with which the towns of Inverness and Whitehaven are supplied, both before and after passing through lead pipes and cisterns, and find these waters to have the same high degree of softness as the water of Loch-Katrine, and also the same decided action upon lead. Yet the injurious action of the metal upon water in use in those towns has never been observed nor even suspected, nor can a trace of metal be found in the water which has passed through lead. In fine, the apprehension of danger from the use of Loch-Katrine water with leaden service pipes is entirely speculative, and cannot fail to be dissipated the moment that reference is made to the experience of other towns supplied with water of equal softness and purity."

SEPARATION OF NICKEL FROM COBALT. BY PROF. LIEBIG.

THE mixture of the two oxides is dissolved in hydrocyanic acid and potash; the solution is then heated for half an hour on the water-bath in an open dish, or, what is better, boiled in a flask. Cyanide of cobalt and potassium and protocyanide of nickel and potassium are produced. Mercury added to the solution throws down all the nickel in the form of oxide, forming cyanide of mercury, whilst the cobalt compound remains unchanged.

Or it may be treated as just described, but instead of adding mercury, the fluid may be allowed to cool, and supersaturated when cold with chlorine; caustic potash or soda is then added in such proportion, that as the protocyanide of nickel separates, it may be again dissolved. At last the nickel is completely separated in the form of black peroxide; but the cobalt compound is not altered by the chlorine, and the nickel thus separated is free of cobalt.—*Ann. der Chem. und Pharm.*, lxxxvii.: *Philosophical Magazine,* No. 47.

PREPARATION OF HYDROFERROCYANIC ACID. BY PROF. LIEBIG.

IF equal volumes of a cold saturated solution of cyanide of potassium and fuming muriatic acid, free from iron, be mixed (the latter being gradually added to the former), pure snow-white hydroferrocyanic acid is precipitated. When dried upon a tile, it dissolves readily in alcohol, and may be obtained in crystals, free from muriatic acid, by treatment with ether and allowing it to stand.—*Ann. der Chem. und Pharm.*, lxxxvii.: *Philosophical Magazine,* No. 47.

WOOD IN CHEMICAL PROCESSES.

DR. FRANKLAND has given to the Chemical Society a discourse "On the Technological Applications of Wood as far as they involved any Chemical Process." He described the methods made use of to impregnate timber and preserve it from decay; and explained the manufacture of paper from wood, exhibiting samples of the production in various stages. The preparations of oxalic acid and of grape sugar, from the same material, were then dwelt on shortly; and the lecturer proceeded to describe the various products of the dry distil-

lation of wood. The only solid product is charcoal; the gaseous are of little value commercially, for, if burnt, they possess very slight illuminating power; but the liquid products are of great interest. They are divided into pyroligneous acid and wood naphtha. The first is best prepared when the hardest woods, such as birch and oak, are roasted. Samples of acetic acid, in all stages of purification, were exhibited. The lecturer then described the various volatile alkalies and oils which are found mixed with the wood naphtha, and detailed a process by which he had obtained the methylic alcohol in a pure condition. He concluded by adverting to his newly-discovered compounds of metals with methyle; and by drawing attention to the magnificent colours said to be possessed by pittacal, which would render it an invaluable pigment, if it could be procured in a manageable state. Many chemists joined in the conversation that ensued; and Mr. Warren De la Rue expressed his appreciation of the paper, made from wood, that had been exhibited.

CHARCOAL RESPIRATORS.

At a late meeting of the Society of Arts, Dr. Stenhouse described a new application of the absorbent and oxidising properties of Charcoal. He proposed to employ a new species of Respirator, filled with powdered animal charcoal, to absorb and destroy any miasmata or infectious particles present in the air in the case of fever and cholera hospitals, and of districts infected by ague, yellow fever, and similar diseases. He said, "I have got such a respirator, made by Ferguson and Sons, Smithfield, instrument makers to St. Bartholomew's Hospital. It fits closely to the lower portion of the face, extending from the chin to within half an inch of the eyes, and projects about an inch on either side of the mouth. It, therefore, includes the nostrils as well as the mouth. The frame of the respirator is made of thin sheet-copper; but the edges are formed of lead, and are padded and lined with velvet, so that it can be easily made to fit tightly to the face. The powdered charcoal is kept in its place by means of two sheets of fine wire gauze, from a quarter to an eighth of an inch apart. As the body of the apparatus is metallic, it has been electro-plated with silver. Electro-plating the respirator with platinum or gold would certainly be an improvement. There is a small opening closed with a wire gauze screen, by means of which the respirator can be filled with charcoal or emptied at pleasure. The respirator is kept in its place by an elastic band passing round the back part of the head. I have employed *animal* charcoal, as the more porous substance; but I should think wood charcoal would answer perfectly well. The object in view is, by filtering the air through such a porous substance as animal charcoal, to intercept the miasmata which may have got mixed with it. These, I think, cannot fail to be absorbed by the pores of the charcoal, where they will be rapidly oxidated and destroyed by the condensed oxygen, with which they will be brought into the most intimate contact. The probability of this expectation being realized is greatly strengthened by the results of repeated trials with the respirator on certain noxious and offensive gases, such as ammonia, sul-

phuretted hydrogen, hydrosulphate of ammonia, and chlorine. I have found that air, strongly impregnated with these gases, and which could not be respired for any length of time, under ordinary circumstances, may be breathed with impunity when the charcoal respirator is worn, the odour of these gases being rendered almost, if not altogether, imperceptible. Any other highly porous substance, such, for instance, as spongy platinum, or pounded pumice-stone, might probably be found to answer perfectly well for filling the respirator; but I have selected charcoal, as the cheapest and most easily available material.

* * * * *

"In addition to the precaution of wearing such a respirator as that just described, persons necessitated to live in especially pestiferous districts might have their houses made as air-tight as possible, with the exception of such openings as are necessary to maintain a proper amount of ventilation. By means of these openings, the air could be freely admitted through gauze, into which the requisite quantity of charcoal had been quilted. The doors of such houses could also be made double, and be constructed of coarse cloth, likewise containing a thin layer of charcoal-powder. As an additional precaution, if it were thought desirable, the walls, floors, and ceilings of houses in very unhealthy districts could be easily lined with mattresses filled with a couple of inches of charcoal-powder. Were these and similar precautions adopted, I confidently anticipate that Europeans will be enabled to reside with comparative impunity in some of the hitherto most pestilential districts of the world."

Dr. Stenhouse, in a letter to the *Journal of the Society of Arts*, adds that ordinary wood charcoal is even more efficacious, as an absorbent and oxidizer of vaporous substances than animal charcoal.

To some persons disposed to question the accuracy of his statements, viz.: 1stly. That charcoal has the power of absorbing and condensing oxygen within its pores; and 2ndly, That it greatly facilitates the oxidation of many easily alterable substances, organic and inorganic; Dr. Stenhouse replies by requesting attention to the following short extracts from the sixth edition of Brande's *Manual of Chemistry*, at page 446, where it is stated, on the authority of M. Theodore de Saussure, that wood charcoal absorbs 925 times its volume of oxygen gas. In an immediately succeeding paragraph the following passage also occurs:—"A piece of well-burned charcoal, cooled under mercury and then introduced into a mixture of oxygen and sulphuretted hydrogen gases rapidly absorbed them, and then became ignited, and caused explosion. (A. Taylor.)" Dr. Stenhouse has repeated Dr. A. Taylor's experiment with a slight variation.—A bit of newly-burned wood-charcoal was passed up into dry ammoniacal gas, a large quantity of which it rapidly absorbed. The charcoal was then introduced into a jar of oxygen. Intense chemical action immediately ensued, much heat was evolved, a quantity of water was produced, and the oxygen disappeared.

After these statements Dr. Stenhouse thinks no reasonable doubt should be entertained either as to the power of charcoal to absorb

and condense oxygen within its pores, or as to its efficacy in facilitating the oxidation of easily alterable substances.

CHARCOAL VENTILATORS FOR DWELLING-HOUSES AND SHIPS.

DR. STENHOUSE considers that the above principle of the Charcoal Respirator may be very advantageously extended, under particular circumstances, to the Ventilation of Ships and Buildings.

If a thin layer of coarsely-powdered charcoal is enclosed between two sheets of wire gauze, and inserted into a suitable frame-work in those portions of ships and buildings where foul air is apt to accumulate, such, for instance, as in the vicinity of water-closets and similar nuisances, all the impurities in the air will be absorbed and retained by the charcoal, while a current of pure air will alone be admitted into the neighbouring apartments. The Charcoal Ventilators should be furnished with a slide at top and bottom, by means of which they may be easily filled or emptied at pleasure. Such an arrangement would frequently be found useful in the close wards of hospitals, and in the impure atmosphere of many of the back courts and mews-lanes of great cities. A layer of charcoal might be often advantageously placed in the lower portions of buildings, immediately under the wooden-flooring, as it would keep the floors warm and dry, and likewise prevent annoyance from any sewerage water or other impurities that might find their way into such situations. These are a few only of the useful applications to which charcoal powder may be made available for sanatory purposes.

PEAT CHARCOAL.

PROFESSOR WAY, in a recent lecture, remarked that, independently of the noxious gases resulting from the putrefaction of animal matter generally, and which consisted principally of sulphuretted hydrogen and sulphuret of ammonia, each particular animal substance, excretionary or otherwise, had its *peculiar* odour, which, although abundantly perceptible by the senses, and, in many cases, as in musk, almost inexhaustible, was inappreciable in weight; therefore, by deodorising a large amount of odour, it was not to be inferred that a large amount of manuring matter was thereby secured. He then enumerated the various single and double deodorisers that had been employed.

He referred to Sir William Burnett's excellent application of chloride of zinc, and to the ordinary chloride of lime; to gypsum (sulphate of lime), and its conversion in ammoniacal atmospheres into sulphate of ammonia and carbonate of lime; to the agreeable odour of pure ammonia, and its power of giving intensity to odours of a disagreeable character, which intensity was lost when the ammonia was withdrawn; and to sulphate of iron (green copperas), which, when powdered and thrown into tanks, turned black, on account of the sulphuret of iron formed on the decomposition of the sulphuretted hydrogen present.

He then proceeded to the consideration of charcoal as a deodoriser. He gave an interesting statement of the peculiar action of charcoals

in general, arising, he believed, from the great amount of surface their spherical interstices presented, and of the particular action and superior value of animal charcoal over all others. He referred to the theory he had been led to form of this peculiar difference, and to a very successful imitation of animal charcoal, which he and Mr. Paine had made, in reference both to deodorising and decolorising properties, from the light porous silica rock, found on Mr. Paine's estate in Surrey: this, when broken up and steeped in heated tar, was put into a gas retort, where the tar was burnt off in the state of very pure gas, and a residuum left of the new silicated charcoal in question.

He explained that in charcoals it was not the amount of carbon they contained that constituted their value, but the mode in which the carbon was distributed; that animal charcoal contained only 10 per cent. of real carbon, while wood charcoal contained 90 per cent. He referred to the large amount of water, 50 or 60 per cent., which peat charcoal took up, and to the fallacious dry state of the manures with which this water-carrier was mixed. He feared this mode of introducing water in a latent state into manures, in many cases, gave a turn in the scale more in favour of the manufacturer than of the farmer. He doubted whether peat-charcoal could be used economically for the purpose of soaking up tank-water; if not, he feared it would prove of no advantage, in other respects, as a remunerative agent to the farmer. It had been long before the public, but had not progressed in market value, as it would have done had its application been successful. He considered it to lead to much error in practice, that the exact nature of the action of charcoal on ammonia was not better understood by the public. Fresh-burnt charcoal would absorb a large quantity of ammoniacal gas, but it was a mistake to suppose that it would consequently abstract ammonia from a liquid impregnated with it; on the contrary, water had the power of displacing from charcoal the whole of the ammonia it had received in a gaseous state within its pores. Peat charcoal did not either make manure or separate it from sewage; it simply rendered manure portable. He exhibited a striking experiment, showing the power of *dry* peat charcoal to arrest odours. Two open tumblers were half filled with the most offensive sewage-matter Professor Way could obtain, and the surface of each mass covered with a film of thin paper and a thin bed of powdered peat charcoal resting upon it. These tumblers were in this state handed round to the members, who ascertained the perfect manner in which the sewage-matter was thus rendered no longer offensive to the smell. He then gave an interesting account of the process of Mr. Stothert, by which sewage-matter was reduced, by a double action of purification, into clear water and inodorous precipitate—a process admirably adapted for sanitary purposes, although not for those of agriculture, as the more valuable manuring matters were held in solution and carried off in the pellucid liquid, while the precipitate was comparatively an inert mass.—*The Chemist.*

NEW KIND OF PEAT CHARCOAL.

M. BUSSON DU MAURIER, *apropos* of the prize of 3000 francs offered by the Societé d'Encouragement of Paris, for the best process by which a fuel adapted for household and manufacturing purposes may be economically prepared from peat, has written to that Society to the effect that he has succeeded in preparing an excellent solid, compact, and tenacious Charcoal, or rather Coke, by distilling peat mixed with small bituminous coal. This coke, he says, is admirably adapted for the forging of steel and other metallurgical operations.

NEW EMBALMING MATERIAL.

DOCTOR FALCONI is said to have discovered a mixture, in the form of a powder, chiefly composed of sulphate of zinc, by which human bodies can be indefinitely preserved. In the case of exhumations for legal purposes, the body may be carried to a convenient place, and kept for the required time, by filling up the coffin with the powder. Bodies may also be transported to a great distance for interment in the same way; this use of it is indeed authorised and recommended by the French police. He has also discovered a liquid for preserving anatomical "subjects" and preparations, the base of which is also sulphate of zinc. This liquid is said to be of remarkable efficacy for this purpose, and is now being used in all the schools of medicine of Paris. Another application of this liquid is for the very absurd process of embalming human bodies—a use, however, which is not likely to be of much importance.—*Cosmos*, vol. v., No. 6.

COMPARISON OF GUNCOTTON AND GUNPOWDER.

A CORRESPONDENT of the *Times* has communicated the following results of his experience of the use of Guncotton over a period of seven years. He had previously addressed the Secretary at War, but without receiving any acknowledgment of his communication.

1. Guncotton, also known as nitrate of lignin, will not explode until raised to a temperature of from 330° to 356°. Whether applied in guns or for blasting rocks it is, weight for weight, from four to six times as powerful as gunpowder.

2. A charge of guncotton of the same force as the usual charge of powder, occupies about two-thirds of the space in a gun, and consequently gives a better effect. For blasting it is compressed and entirely concealed in cartridges, with a safety fuse attached.

3. Guncotton explodes more rapidly than gunpowder—an invaluable quality for ships firing in a seaway, for firing shells, and it insures somewhat more accuracy in firing from the shoulder.

4. Guncotton makes very little smoke, and leaves hardly any solid or liquid residuum. The former property is of great importance when firing between decks, in affording a clear view of the object fired at, and generally in every battle or naval engagement. To the latter quality is due the fact, that the gun hardly becomes foul with the longest use, and that the corrosion of the metal is also less.

5. The gun is not so rapidly heated. No priming is required, as the flame from the cap passes down the touch-hole sufficiently far to ignite the cotton below.

6. It misses fire much less often than gunpowder, and this is the same on the wettest day as the dryest.

7. Guncotton is not at all injured by being wetted; and may be kept in fresh or salt water for many years without being at all affected. No apprehension need be entertained for the magazine of a ship catching fire, as, if the cotton is

not kept always in water, arrangements may be made for rapidly wetting it. There would no longer be any danger for magazines, as the cotton can be dried rapidly in small quantities as required.

8. Guncotton can be manufactured in the simplest manner. Five minutes' immersion in nitric acid, and half an hour's washing in a running stream, will complete the operation. A besieged city may provide easily an endless supply of ammunition.

By manufacturing the cotton in a particular form, the charges for artillery can be converted, in an emergency, into musket charges; bullets and a bale of cotton would supply the place of cartridges in any emergency.

The defects which have been urged against guncotton are—

1. That it may explode by a blow, or in ramming down. This is never the case unless the blow has by some means produced a temperature of 330°. In practice this temperature is not ordinarily met with, except in connexion with a fire, when powder would be very nearly, if not equally as dangerous. In many thousand trials no accident has ever occurred.

2. That it may burst the gun. Accidents of this kind have only arisen from using a charge of cotton equivalent to many times the usual charge of powder.

3. That it is dangerous to manufacture. One very serious accident has arisen, but there is great reason to attribute it to means being used for preparing the cotton which would not have been used for gunpowder. The experience of the early gunpowder manufacture shows that this is not a reason for hesitating, and it is reasonable to think that the simplicity of the manufacture may even render it less hazardous.

There is, however, a danger in using it, which arises from the difficulty of persuading men that a substance identical in appearance with common cotton is quite as dangerous as gunpowder. The accidents which have happened with it will, on inquiry, be found to be more or less attributable to this cause. As a proof of the estimation in which it is held by the Austrian Government, they have recently given Professor Schonbein, of Basle, the inventor, 2500*l.*

NITRIC ACID AND COTTON.

Mr. E. A. Hadow has read to the Chemical Society a paper "On the Substitution Compounds obtained by the Action of Nitric Acid on Cotton." The author described four several compounds, varying in solubility in ether, and other properties, as well as in ultimate composition. Suggestions were made as to the best method of preparing collodion. A new re-action was employed in the analytical investigation, namely the perfect restoration of the cotton from these compounds, by means of sulphuret of potassium. In the discussion of this paper, Dr. Gladstone stated his belief, that the more explosive guncotton, analyzed by him some years since, was the second compound of Mr. Hadow.

PRESERVATION OF FRESH MEAT.

Mr. G. Hamilton has communicated to the British Association the results of his experiments on the Preservation of Fresh Meat. This inquiry was undertaken with a view of discovering a method by which beef could be brought in a fresh state from South America. The experiments were made by inclosing pieces of beef in bottles containing one, or a mixture of two or more of the following gases:—chlorine, hydrogen, nitrogen, ammonia, carbonic acid, carbonic oxide, and binoxide of nitrogen. Of these the last two only possessed the power of retarding putrefaction. Beef that had been in contact with carbonic oxide for the space of three weeks, was found to be perfectly fresh, and of a fine red colour. Binoxide of nitrogen is capable of preserving beef from putrefaction for at least five months, during

which time the beef retains its natural colour and consistence. When meat that had been preserved by the last process was cooked by roasting, it was found to possess a disagreeable flavour. If cooked by boiling, the ebullition must be continued for a much greater length of time than is necessary for fresh meat.

Dr. Calvert remarked, that he had opportunities of observing the well-known valuable anti-putrid properties of carbolic acid, and instanced the case of the carcase of a horse that was at present in a fresh state, although four years had elapsed since it had been soaked in liquor containing the acid. He recommended the use of this acid for preserving bodies intended for dissection, as it neither affects the tissues nor discolours the organs.

RELATIVE VALUE OF DIFFERENT KINDS OF MEAT AS FOOD. BY MARCHAL OF CALVI.

M. Marchal took 20 grammes of the muscles of the pig, ox, sheep, calf, and hen, which contained neither sinews, or cellular tissue, or adhering fat, except what naturally exists between the muscular fibres; he dried them in a water bath for several days, and thus ascertained the loss which each sustained by desiccation. The following are his results in 100 parts :—

	FIRST EXPERIMENT.		SECOND EXPERIMENT.	
	Solid Matter.	Water.	Solid Matter.	Water.
Pork	29·45	70·55	30·25	69·75
Beef	27·70	72·30	27·50	72·50
Wether Mutton .	26·55	73·45	26·35	73·65
Chicken	26·35	73·65	26·30	73·70
Veal	26·00	74·00	25·55	74·45

According to these numbers we should arrange the meats in the following order of their relative nutritive powers:—pork, beef, mutton, chicken, veal. This order is, however, not the true one; because the leanest meat contains a certain amount of fat, and because this substance is not so important an article of food as the pure muscles, it is necessary to ascertain how much a certain quantity of meats contain before we can judge properly of its relative nutritive value. M. Marchal accordingly treated the dried flesh with ether to dissolve out the fat, and obtained the following results :—

	Fat soluble in ether.	Pure muscle insoluble in ether.
Beef	2·54	24·95
Chicken	1·40	24·87
Pork	5·97	24·27
Mutton	2·96	23·38
Veal	2·87	22·67

The last table shows that the true order should be beef, chicken, pork, mutton, and veal, a result which experience confirms. It may, however, be remarked, that there is considerable difference between the same kind of meat derived from different animals; and that the same amount of two different kinds of beef broth, both containing the same amount of water, may have very different nutritive values. Further investigations are required upon this point.—*Comptes Rendus; Dublin Journal of Industrial Progress*, No. 5.

INDIGO IN HUMAN URINE.

Dr. Arthur Hill Hassall has found the occurrence of Indigo in Human Urine to be more common than the author was led to anticipate from his first inquiries. He furnishes additional proofs of the blue colouring matter in question being really indigo, by converting it into isatine and aniline. Contrasting its chemical and physiological relations with hæmatine and urine pigment, he shows that indigo is closely allied in its nature and origin to those substances; and he considers that when indigo is met with in urine in considerable amount, it forms a vehicle for the elimination of any excess of carbon contained in the system. This view is borne out by the important fact that the greater number of cases in which indigo has been observed to be developed in the urine in large amount have been cases of extensive tubercular disease of the lungs, and in which the decarbonizing functions of those organs are greatly impaired.—*Proceedings of the Royal Society.*

PRESENT STATE OF AGRICULTURE.

A perfected Agriculture can result only from nice adjustments—a determination of the nature of the matter to be dealt with, and its inherent forces, combined with a special knowledge of the individual organization and its functional wants. Defective products are mainly due to functional wants; there are no truly diseased products or disorganized organs. Graduate the supplies to the nutriment powers, satisfy the capacities of the plant at the proper time, and, all other things being adjusted, the husbandry is perfect; or give the plant its climate, temper the heat and moisture to its constitution, make its physical condition happy, and put within its reach the assimilating elements, and enough is done to ensure productive returns. But to do this requires probably more knowledge of soils, and of the cultivated vegetables, than we now possess. The object is to supply without waste, to cheapen the product by the expenditure of the least labour, and restricting the food to the kind and quantity, so that it shall not be lost by escaping into the air, or being washed to remote parts by rains. It is evident that adjustments require a complete insight into the physiology of vegetation—its incipient stage, its maturing strength, the peculiar or special products to be formed, the elements composing them, and the best form in which these elements can be combined to meet all the wants of the being. As already said, functional endowments must be considered; hence, to pursue that course with a plant which will give it an early vigorous constitution, a full development of its organs in its first stages, and the foundation is laid for the full amount of the products sought.—*Emmons's Natural History of New York.*

SILICA, AND ITS APPLICATION TO THE ARTS.

The Rev. J. Barlow has communicated to the Royal Institution a paper, of which the following is an abstract:—

Silica is one of the most abundant substances known. Quartz,

common sand, &c., flint, chalcedony, opal, &c., and a variety of sand described by Mr. J. T. Way,* may respectively be taken as examples of crystallized and uncrystallized silica. Under all these forms silica is capable of combining with bases as an acid. Heat is however essentially necessary to effect this combination, a combination of which all the well-known silicates, whether natural, as felspar, mica, clay, &c., or artificial, as glass, slags, &c., are the results. The common forms of insoluble glass are produced by the union of silica with more than one base. But when combined with an alkaline base only, silica forms a soluble glass, the degree of solubility of which depends on the proportion which the silicic acid bears to this alkaline base. . . . This soluble silicated alkali (or water-glass) may be prepared by various processes. If sand be used, 15 parts of fine sand, thoroughly incorporated with 8 parts of carbonate of soda, or with 10 of carbonate of potash, and one of charcoal, fused in a furnace, will produce a silicated alkali which is soluble in boiling water. Messrs. Ransomes obtained this silicated alkali by dissolving broken flints in a solution of caustic alkali at a temperature of 300° Fahr. And more recently, Mr. Way has observed that the sand which he has described will combine with caustic alkali at boiling heat, also producing a water-glass.

This Water-glass has been applied to several important purposes, three of which were specially noticed.

1. *To protect Building-stones from decay.*—The stone surfaces of buildings, by being exposed to the action of the atmosphere, become liable to disintegration from various causes. Moisture is absorbed into their pores. The tendency of their particles to separate, in consequence of expansion and contraction, produced by alternation of temperature, is thus increased. Sulphurous acid is always present in the atmosphere of coal-burning cities, and cannot but corrode the calcareous and magnesian ingredients of oolites and dolomites. It is true that good stone resists these sources of injury for an indefinite time, but such a material is rarely obtained. As a preventive of destruction, whether arising from physical or chemical causes, it has been proposed to saturate the surfaces of the stones with a solution of the water-glass.

It is well known that the affinity of silica for alkali is so feeble that it may be separated from this base by the weakest acids, even by carbonic acid. According to the expectation of those who recommend the silification of stone, the carbonic acid of the atmosphere will set the silica free from the water-glass, and the silica, thus separated, will be deposited within the pores and around the particles of the stone. The points of contact of these particles will thus be enlarged, and a sort of glazing of insoluble silica will be formed, sufficient to protect the stone against the effects of moisture, &c. This cause of protection applies chiefly to sandstones. But wherever carbonate of lime or carbonate of magnesia enters notably into the composition of the building-stone, then an additional chemical action,

* *Quarterly Journal of Chemical Society*, July 1, 1853, and Journal of Royal *Agricultural Society*, vol. xiv. part 1.

also protective of the stone, is expected to take place between these carbonates and the water-glass. Kuhlmann remarks, "Toutes les fois que l'on met en contact un sel insoluble avec la dissolution d'un sel dont l'acide peut former avec la base du sel insoluble un sel plus insoluble encore, il y a échange; mais le plus souvent cet échange n'est que partiel."* In consequence of this "partial exchange" an insoluble salt of lime may be looked for whenever a solution of water-glass is made to act on the carbonate of lime or carbonate of magnesia existing in oolitic or dolomitic building-stones.

This expectation, however, has not been altogether sanctioned by experiment. A gentleman, eminently conversant with building materials,† immersed a piece of Caen-stone in a solution of silicate of potash in the month of January, 1849. This fragment, together with a portion of the block from which it had been separated, was placed on the roof of a building in order that it might be fully exposed to the action of atmosphere and climate. After five years the silicated and the unsilicated specimens were found to be both in the same condition, both being equally corroded. These specimens were exhibited in the Theatre of the Institution. But whatever ultimate results may ensue from this process, the immediate effects on the stone are remarkable. Two portions of Caen-stone were exhibited, one of which had been soaked in a solution of water-glass two months before. The surface of the unsilicated specimen was soft, readily abraded when brushed with water, and its calcareous ingredients dissolved in a weak solution of sulphurous acid. The silicated surface, on the other hand, was perceptibly hard, and resisted the action of water and of dilute acid when similarly applied.‡

II. Another proposed use of the water-glass is that of *hardening cements, mortar*, &c., so as to render them impermeable by water.

Fourteen years since Anthon§ of Prague proposed several applications of the water-glass. Among others he suggested the rendering mortars water-proof. He also suggests that this substance might be beneficially employed as a substitute for size in whitewashing and staining walls. It was demonstrated by several experiments that carbonate of lime, mixed up with a weak solution of water-glass, and applied as a whitewash to surfaces, was not washed off by sponging with water, and that common whitewash, laid on in the usual manner with size, was rendered equally adhesive when washed over with water-glass.

III. *The Stereochrome of* Fuchs.—The formation of an insoluble cement by means of the water-glass, whenever the carbonic acid of

* *Expériences Chimiques et Agronomiques*, p. 120.

† Charles H. Smith, Esq., one of the authors of the *Report on the Selection of Stone for the Building of the New Houses of Parliament.*

‡ Silliman's *American Journal*, January, 1854, contains a notice of the application of the water-glass to the decaying surfaces in the Cathedral of Notre Dame in Paris.

§ *Neuere Mittheilungen über die Nutzanwendung des Waser-Glases*, 1840. This subject has also been fully treated by Kuhlmann in his *Mémoire sur l'Intervention de la potasse ou de la soude dans la formation des chaux hydrauliques*, &c., *1841.—Expériences Chimiques et Agronomiques.*

the atmosphere acts on this substance, or whenever it is brought in contact with a lime-salt, has been applied by Fuchs to a most important purpose. The stereochrome is essentially the process of fresco secco* invested with the capability of receiving and perpetuating works of the highest artistic character, and which may be executed on a vast scale. Fuch's method is as follows :†

"Clean and washed quartz-sand is mixed with the smallest quantity of lime which will enable the plasterer to place it on the wall. The surface is then taken off with an iron scraper, in order to remove the layer formed in contact with the atmosphere; the wall being still moist during this operation. The wall is then allowed to dry: after drying it is just in the state in which it could be rubbed off by the finger. The wall has now to be *fixed*, *i. e.* moistened with water-glass.‡ [An important point is not to use too much water-glass in moistening the wall.] This operation is usually performed with a brush. The wall must be left in such a condition as to be capable of receiving colours when afterwards painted on. If, as frequently happens, the wall has been too strongly fixed, the surface has to be removed with pumice and to be fixed again. Being fixed in this manner, the wall is suffered to dry. Before the painter begins, he moistens the part on which he purposes to work with distilled water, squirted on by a syringe. He then paints: if he wishes to repaint any part, he moistens again. As soon as the picture is finished, it is syringed over with water-glass. After the wall is dry, the syringing is continued as long as a wet sponge can remove any of the colour. An efflorescence of carbonate of soda sometimes appears on the picture soon after its completion. This may either be removed by syringing with water, or may be left to the action of the atmosphere." Not to dwell on the obvious advantages possessed by the stereochrome over the real fresco (such as its admitting of being retouched and its dispensing with joinings), it appears that damp and atmospheric influences, notoriously destructive of real fresco, do not injure pictures executed by this process.

"The following crucial experiment was made on one of these pictures. It was suspended for twelve months in the open air, under the principal chimney of the New Museum at Berlin: 'during that time it was exposed to sunshine, mist, snow, and rain,' and nevertheless 'retained its full brilliancy of colour.'"

The Stereochrome has been adopted on a grand scale by Kaulbach in decorating the interior of the great national edifice at Berlin already alluded to. These decorations are now in progress, and will consist of historical pictures (the dimensions of which are 21 feet in height and 24¾ in width), single colossal figures, friezes, arabesques, chiaro 'scuro, &c. On the effect of the three finished pictures, it has been remarked by one whose opinion is entitled to respect, that they have all the brilliancy and vigour of oil paintings, while there is the absence of that dazzling confusion which new oil paintings are apt to present, unless they are viewed in one direction, which the spectator has to seek for.

Mr. A. Church has suggested that if the surface of oolitic stones (such as Caen-stone) is found to be protected by the process already described, it might be used, as a natural *intonaco*, to receive

* Vide Eastlake's *Materials for a History of Oil Painting*, p. 142.

† These particulars were obtained by Dr. Hofmann from Mr. Echter. A stereochromic picture by Echter and a sample of the water-glass as prepared in Munich, were also exhibited by Dr. Hofmann.

‡ The composition of the specimen was—

	per cent.
Silica	23·21
Soda	8·90
Potash	2·52

[The specific gravity of the solution 3·81.]

coloured designs, &c., for exterior decorations; the painting would then be cemented to the stone by the action of the water-glass.

Mr. Church has also executed designs of leaves on a sort of terra cotta, prepared from a variety of Way's silica rock, consisting of 75 parts clay and 25 of soluble silica. This surface, after being hardened by heat, is very well adapted for receiving colours in the first instance, and for retaining them after silication.

SEWERAGE OF MANUFACTURING TOWNS.

THE analysis, made by Dr. Wrightson, of a natural deposit from the Sewerage of Birmingham, formed near the embouchure of several sewers opening into the Rea, showed the absence of all ammoniacal salts and the scarcity of phosphates, particularly alkaline phosphates; and, at the same time, the presence of a large quantity of protoxide of iron, also of zinc, copper, and other metals in the state of oxides and sulphurets. These metallic salts, in the sewers, absorbed the sulphuretted hydrogen and ammonia generated by decaying vegetable and animal matter, and, doubtless, contribute to promote the health of the town. The deposit contained when dried only 1·4 per cent. of nitrogen (not as ammonia) and 3·5 of earthy phosphates; but about 11·7 of protoxide of iron, besides zinc, copper, and other metals to the extent of two or three per cent. The author hoped these facts would not be lost sight of by corporations and other bodies interested in economizing town sewerage.—*Proceedings of the British Association.*

ON THE EQUIVALENCY OF STARCH AND SUGAR IN FOOD. BY MR. J. B. LAWES AND DR. GILBERT.

AT the Meeting of the British Association at Belfast, the authors had given a paper, "On the Composition of Food in relation to Respiration and the Feeding of Animals," in which they had illustrated, by reference to experiment, that as our current food-stuffs go, it was the amounts they supplied of the assimilable non-nitrogenous rather than those of the nitrogenous constituents, which measured both the amounts consumed by a given weight of animal, within a given time, and the amount of increase obtained from a given weight of food. The results, which formed the subject of the present communication, afforded further illustration of some of the points brought forward in the former one; but they had been arranged with reference to certain practical questions as well as to the more scientific bearings of the subject. Thus, those interested in the growth of sugar had long wished to obtain the introduction of the lower qualities of that article, for feeding purposes, duty free. The subject of the remission of the malt-tax, for the same object, had also frequently been agitated. According to the results of experiment (numerous tables of which were exhibited in the room, and in which the animals had been made to rely for about one-third of their total food upon the starch or sugar employed), it appeared that absolutely identical amounts of the dry substance of the starch and sugar, which had thus been tried against each other, had been both consumed by a given

weight of animal within a given time, and required to yield a given weight of increase. The identity, therefore, in feeding value, which had, from the known chemical relationship of these two substances, been hitherto assumed, was thus experimentally illustrated. If, then, sugar had no higher feeding value than starch, the relative prices, weight for weight, of sugar and the starchy grains generally used for feeding purposes, but which also supplied the needful nitrogenous constituents, would afford an easy means of estimating the probable economy of the use of the former.

These new results were also consistent with direct experiments, published by the authors some time since, "On the Comparative Feeding Value of Malted and Unmalted Grain." It was true that malt and other saccharine matters might serve, in some degree, to give a relish to the food, and thus induce the animal to consume more, which in "fattening" is always a consideration: but this incidental benefit could not counterbalance much increased cost; hence, it did not seem probable that any extensive use of malt for feeding purposes would be such a boon as had been supposed. The proved equivalency of starch and sugar in food was also of interest in reference to some other of the views maintained by the authors in their former paper. Thus, it had been shown that a fattening animal might store up very considerably more fat than existed ready formed in its food; and this produced fat was, doubtless, in a great measure, due to the starchy and saccharine substances, which constitute so large a proportion of the non-nitrogenous constituents of our staple vegetable foods. It was these, too, which, in practice, served largely to meet the requirements of the respiratory function, which it had been shown, under ordinary circumstances, measured to such an extent the amount of food demanded by the animal system.

IODINE IN THE MINERAL AND VEGETABLE KINGDOMS.

DR. S. MACADAM, in a communication to the British Association, states that an experiment where 100,000 cubic feet of air were analyzed, and one recently undertaken by him, where 50 gallons of rain water were examined, having failed to yield a trace of Iodine, he was inclined to think that other and more carefully conducted experiments were required before the statement advanced by Chatin—that an appreciable amount of iodine was present in the atmosphere—could be admitted. The author had found a trace of iodine in 100 gallons of the water used for domestic purposes in Edinburgh; as also in about 60 land plants, some of which were edible,—such as potatoes, wheat, barley, oats, beans, peas, pears, apples, and gooseberries. The presence of iodine in the food of animals necessitated its introduction into the system of the animal, and, for a time at least, its retention there. The author accordingly found iodine in the cat, the dog, the pig, the cow, the horse, and man. In every instance but one, muscle was the only part of the animal frame employed. In the horse, however, the lungs, liver, heart, spleen, and kidneys, as well as the muscle, were examined; and each organ yielded iodine. The milk and blood of the cow, and common eggs, gave a like affir-

mative result. The passage of iodine from the animal system had also occupied the attention of the author. By wearing a starched gauze respirator for six nights (about 50 hours), it was apparent, from no blue or rose tint being imparted to the gauze, that no iodine had left the system by that road; whilst other experiments showed that the iodine compounds accompanied the other saline matters in their passage from the animal. No direct experiments had been made on soils; but considering that iodine is uniformly a constituent of limestone rocks, and that these are always present in and applied to soils, the author believed that the latter must, to a greater or less extent, contain iodine.

PECULIARITIES DISCOVERED IN LIQUID CAOUTCHOUC.

MR. T. C. ARCHER has stated to the British Association that he has discovered the cause of the black colour in India rubber. The old opinion that the black colour was owing to the bottles and other forms of the material being dried by the natives in the chimneys of their dwellings is incorrect; for caoutchouc has a peculiar property, by which light acts upon it very powerfully, and produces the black colour. In proof of this, Mr. Archer exhibited specimens of liquid India rubber in white glass bottles. This liquid had been imported for making experiments as to its power of receiving brilliant colours; and it had evidently received an addition of some liquid ammonia, probably for the purpose of preserving its liquidity, and preventing decomposition. In colour and consistency, the liquid caoutchouc resembles milk; but two small portions in white glass bottles had, by the action of light, become jet-black next the glass, whilst the interior whiteness and liquidity were unimpaired; whereas, a similar sample of the material in a green glass bottle retains its original character. Mr. Archer thought this peculiar susceptibility to the action of light was well worthy of notice. He exhibited a specimen of caoutchouc from the West Coast of Africa, the quality of which is evidently of a very superior character.—*Athenæum*, No. 1408.

THE TALBOTYPE.—TALBOT *v.* LAROCHE.

THIS action for the infringement of the Talbotype Patent was tried in the Court of Common Pleas, Dec. 18—20 last.

Sir F. Thesiger, Mr. Grove, and Mr. Field, were counsel for the plaintiff; and Mr. Serjeant Byles, Mr. Willes, and Mr. Hannen, for the defendant.

It appeared that the plaintiff, who is a gentleman of property, residing at Laycock Abbey, in Wiltshire, has for years devoted himself to science, and, knowing that Sir H. Davy and Wedgwood had, in 1802, produced the representation of objects on paper by means of sunlight, although they were unable to fix them permanently, had instituted a series of experiments, which resulted in his taking out a patent for what he termed "Calotype," although it has since been named "Talbotype," out of compliment to the inventor. He read a paper on the subject to the Royal Society in 1840, and exhibited in *1841 portraits* taken by his process in Paris, where the system of

Daguerre was then making progress. He took out his patent later in that year, and received the Rumford medal for his invention in 1842. Mr. Talbot has since, by means of letters published in *The Times*, given the benefit of his invention to the public at large, reserving to himself, however, the right of taking portraits for the purpose of sale—a right which he has exercised by granting licences to many persons to use that branch of art. The specification of the patent was shortly as follows:—"The first part is a method of making paper extremely sensitive to the rays of light. I select the best writing-paper. I dissolve 100 grains of crystallized nitrate of silver in 6oz. of water. I wash one side of the paper with this solution. I dry the paper, next I dip it in a solution of iodide of potassium. I then dip it in water, and dry it lightly with blotting-paper. The paper thus far prepared, may be called iodized paper. When wanted for use, I take a sheet of iodized paper, and wash it with gallo-nitrate of silver, which is made by dissolving nitrate of silver with water and acetic acid, and adding to the whole an equal quantity of gallic acid. The paper, thus prepared, is placed in a camera obscura, so as to receive the image formed in the focus of the lens. If the object is bright or the time long enough, a sensible image is perceived upon the paper when it is withdrawn, but when the time is short or the object dim, no image is visible on the paper, which is, nevertheless, impressed with an invisible image, which I have discovered the means of causing to become visible. I wash the paper with gallo-nitrate of silver, and then hold it before the fire, and in a short time the image appears. Those parts of the paper on which the light has acted most become brown or black. In order to fix the picture I wash it with bromide of potassium. The picture thus obtained will be reversed with respect to natural objects, but it is easy to obtain one conformable to nature by taking a second sheet of calotype paper, and placing it in contact with the first; a board is put beneath them and glass above, the whole is pressed together by screws, and, being then placed in the daylight for a short time, a copy is formed on the second sheet. The second sheet is equally good if common photographic paper is used. I claim, first, the employing gallic acid or tincture of galls in conjunction with a solution of silver, to render paper which has received a previous preparation more sensitive to the action of light; secondly, the making visible photographic images upon paper, and the strengthening such images when faintly visible, by washing them with liquids, which act upon those parts which have been previously acted on by light; thirdly, the obtaining portraits from the life by photographic means upon paper; fourthly, the employing bromide of potassium for fixing the images." This patent has been followed by three other patents taken out by the plaintiff, in order to secure certain improvements in the process. The action was brought because the defendant, who is a photographic artist on the collodion system, has, by means of that system, infringed the plaintiff's first patent,

Professor Miller, Mr. Brande, Mr. Hoffman, Mr. Medlock, Mr. Crookes, Mr. Maskelyne, and other scientific gentlemen, were ex-

amined in support of the plaintiff's case, to show that the collodion process, although in some respects different, is essentially an imitation of the Talbotype process, and, even in the most favourable view of the defendant's case, can only be considered as a further improvement on the plaintiff's process. They insisted that collodion was used only as a medium in the place of the plaintiff's prepared paper, and had no photographic power *per se*, and also that the pyrogallic acid employed by the defendant was simply more rapid in its process than the gallic acid of the plaintiff.

The defendant rested his case on two grounds—first, that the plaintiff's invention was not new, as the process had been discovered and communicated to the public in 1839 by the Rev. J. B. Reade; and next, that the collodion process was altogether different from the Talbotype, and, therefore, no infringement of the patent. The Rev. J. B. Reade, who is now vicar of Stone, near Aylesbury, was examined, and gave evidence, that when he lived at Peckham, he had, in the course of experiments, discovered two processes for obtaining sun pictures. He knew that Sir H. Davy had stated that leather was more sensitive to light than paper, and he therefore, by means of chloride of silver with an infusion of galls, obtained an image which he fixed with hyposulphate of soda. By these means he produced the picture of a magnified flea and other objects which he exhibited at a *soirée*, given in 1839, by the late Marquis of Northampton to the Royal Society. Mr. Reade, by his second process, used cards glazed with carbonate of lead; he washed these cards with acetic or muriatic acid, and then floated them in iodide of potassium, so as to produce an iodide of lead. He next washed the surface of the card with nitrate of silver, and obtained the image by superposition, while he washed it with an infusion of galls. The effect of the sunlight was immediately to blacken the cards. He fixed the image in the same way that he used in the first process. He was once surprised to find that a figure was brought out after the paper had been momentarily exposed to the light, but he had no idea of the mode of developing the invisible image until he read the account of Mr. Talbot's discoveries. Mr. Reade communicated the results of his experiments in a letter to Mr. Brailey, who read the letter at two lectures given by him, in 1839, on photography; but the letter made no mention of the use of iodide of potassium in the experiment of the glazed cards.

The second ground of defence was, that the collodion process is essentially different from the Talbotype. The collodion process was discovered, in 1851, by Mr. Archer, and is as follows:—Take the collodion of commerce, which is gun cotton and ether, mix it in certain proportions either with iodide of potassium, of ammonia, or of cadmium, pour the mixture on a glass, where it forms a film, immerse the film in a bath of nitrate of silver, and then place it in the camera; when withdrawn develope it by pyrogallic acid, or protosulphate of iron, or protonitrate of iron, and finally fix the image with hyposulphate of soda. The image thus obtained is an amphitype, it appears negative, but becomes positive if anything black is placed on

the back of the film, so that it is either negative or positive according to the transmission of light. The negative image likewise produces a positive when transferred to prepared paper.

Dr. Normandy, Dr. Stenhouse, Mr. R. Hunt, Mr. Heisch, Mr. T. Taylor, Mr. Thornthwaite, Mr. Eliot, and other scientific persons gave evidence that collodion possessed unknown photographic properties, and that pyrogallic acid was more highly sensitive and rapid in its action, and was, in many respects, different from gallic acid; indeed, some of the witnesses gave their opinion that pyrogallic acid was a misnomer, and that the substance was no acid at all. As a proof of the instantaneous action of the collodion process, portraits of animals taken when in the act of motion were shown in Court, and also beautiful views of Elsinore, and the Three Crown Battery at Copenhagen, taken on board of Her Majesty's ship *Calliope*, when passing those places at the rate of 11 knots an hour. The plaintiff likewise produced many views taken by the Talbotype process, and one, not excelled by any in Court, of Laycock Abbey, taken in the year 1842.

The Chief Justice summed up, with remarkable clearness and precision. He pointed out that the plaintiff had made discoveries in the photographic art, had communicated those discoveries to the Royal Society, and had therefore given the benefit of them to the world, but he had afterwards taken out a patent for new and fresh inventions, which he described in his specification. In the first part, however, of that document, he described the method of making iodized paper, but did not claim it as part of the invention. The specification then showed how to make that iodized paper more sensitive by washing it in gallonitrate of silver, which was made by a mixture of nitrate of silver and acetic acid with gallic acid. He claimed, then, first, the employment of gallonitrate of silver on iodized paper; secondly, the use of gallonitrate of silver, or an equivalent, for the purpose of developing and strengthening the photographic image; and, thirdly, the obtaining portraits from the life by the previously described means. The fourth claim was not in dispute between the parties. His Lordship stated that the first question for the jury was whether Mr. Reade had previously discovered and published any material part of the claims set up in the patent. Mr. Reade's first process employed chloride of silver, and not nitrate of silver, and was therefore different from the plaintiff's discovery. His other process, however, with the glazed cards was, in reality, identically the same with the plaintiff's, as regarded the method of preparation for giving sensitiveness: gallonitrate of silver was employed in both. But Mr. Reade had not mentioned in his letter the use of iodide of potassium, so that in that respect, whether he had used it or not, his description of the method was different from that employed by the plaintiff, who used iodized paper. The letter therefore only proved that Mr. Reade was aware of the combination of nitrate of silver with gallic acid as a sensitive agent, and the publication of the letter by Mr. Brailey's lectures could not carry that part of the case further. The second question for the jury was as to the infringement by the defendant,

and on this point his Lordship remarked that the wonderful discovery of the latent image was entirely due to Mr. Talbot, who had that high merit. It was the foundation of all that followed, but it was not the subject of a patent, as from its nature it could not be so. With regard to the collodion process, when the collodion was put into the camera it contained iodide and nitrate of silver, but no gallic acid —a material which was essential to the plaintiff's process. It followed, therefore, that there must be something of a highly sensitive character in collodion equivalent to gallic acid, and as yet unknown. Another point of the second question was whether, after the respective substances were withdrawn from the camera, the material applied by the defendant was the same, or a chemical equivalent with that employed by the plaintiff, or, in other words, the point was whether pyrogallic acid was the same or a chemical equivalent with gallo-nitrate of silver; if it was either, there was an infringement of the patent. The evidence had been pointed to a distinction between pyrogallic and gallic acid, but the second claim of the specification, by using the word "liquids," meant gallo-nitrate of silver, and therefore this latter body must be compared with pyrogallic acid. On the whole, the jury were to consider, as to the question of novelty, did Mr. Reade know of the use of nitrate of silver with gallic acid in connexion with iodide of potassium, and did he publish such discovery before the date of the plaintiff's patent? And as to the question of infringement, was the use of collodion with nitrate of silver and iodide of potassium the same with the use of paper prepared with nitrate of silver, iodide of potassium, and gallic acid? And, further, was pyrogallic acid the same or a chemical equivalent with gallo-nitrate of silver?

The jury retired, and returned with a verdict that the plaintiff was the first inventor, but that there was no infringement, thereby deciding in favour of the defendant.

NEW PROCESSES IN PHOTOGRAPHY.

Collodion Negatives.—Mr. G. R. Berry has communicated to the British Association the following paper:—There appears to have been a great difficulty with many operators in obtaining that requisite intensity of negative collodion proof that shall by the after printing yield satisfactory positive paper impressions. Selecting from the formulæ generally followed, the author of this paper applied chloride of gold to the negatives he desired to strengthen, in the proportion of one grain to an ounce of water; and if this did not produce the desired result, he, after washing away the excess of chloride, floated over the proof a solution of sulphide of ammonium, varying in strength from 3 to 40 drops to 1 oz. of water. By this means, impressions so feeble as to be hardly visible by transmitted light became capable of yielding satisfactory results when used for printing. One difficulty remained:—the collodium film, at all times tender while moist, becomes so easily disrupted from the glass plate after the application of any of the strengthening processes, that the acquisition of a perfect negative was the exception and not the rule. This obstacle may be easily surmounted by allowing the photograph to dry after being developed and fixed either by cyanide of potassium or hyposulphite of soda, and then varnishing in the usual way. The photograph may then at any period of time be safely strengthened by repeating the gold and sulphide of ammonium process, observing to use rectified spirit of wine instead of water as the menstruum for the gold and sulphide. The tenacity of the varnish insures the safety of the collodion film, and another coat of varnish completes the process. The author found that by the use of gallic acid in his

silver bath the time of exposure was much prolonged in the camera, but the developed pictures proved of extraordinary intensity, and by this means he has at all times been able to produce satisfactory negatives, provided always that the collodions employed be not made sensitive by iodide or bromide of ammonium. It is true that a portion of gallate of silver soon precipitates, but silver solutions of moderate strength always retain in solution a portion of the precipitant; and this fact has been made use of by the author, Mr. Thomas and some others, by adding excess of moist iodide of silver to a new silver bath, to obviate the tendency it has to dissolve out the film of iodide of silver on the collodion plate. When using a bromide as a sensitizing agent, bromide of calcium has been found most effective; the nitrate of lime resulting from its decomposition in the silver bath having no detrimental action. The formula is as follows:—bromide of calcium 4 grains; dissolve in spirit of wine 2 drachms; add rectified ether 6 drachms, gun cotton *quan. suff.* The silver bath used must be 60 grains to the ounce. The bromized collodion is tolerably rapid, and, unlike most others, improves by age, even beyond a twelvemonth. The author has used the following formula with a simple 30 grain silver bath, and has obtained in all the varying conditions of light, whether of views or portraits, any amount of vigour desired:— The collodion: Take pure iodide of potassium, any quantity; triturate this in a glass mortar with spirit of wine, 54 over proof, until the spirit is unable to dissolve more of the iodide. Take of this solution 3 parts, sulphuric ether, free from acid, 5 parts; mix and dissolve in it gun cotton, to form a tough and rather thick film. The developing agent is, pyro-gallic acid 2 grains, glacial acetic acid 20 drops, spirit of wine 1 drachm, water to make up one oz.

Light.—A novel application of the combustion of zinc has been discovered by Mr. Wenham. He takes fine zinc parings or shavings, and forms them into a pellet, which, when ignited, affords a brilliant, and it is said, a steady light for photographic purposes.

Photography for War Purposes.—Mr. S. Highley has communicated to the British Association the following "Hints on the Management of some Difficult Subjects in the Application of Photography to Science, and the Means of applying Photography to War Purposes in the Army and Navy." The author produced photographic delineations of the human skull, to show its value to the surgical and anatomical student, observing that by its aid many appearances of great use and interest might be preserved. He had made a variety of experiments with the microscope, and showed numerous specimens of photographs, which he had made, and which were illustrative of the most minute objects, such as the probosces of flies, the animalculæ of water, and specimens of minute zoophytes. He exhibited the most approved photographic apparatus, and minutely described its operations. Mr. Highley then displayed the moveable apparatus sent to the East, to be used by the Sappers and Miners, in order to ascertain the description of the forts at Sebastopol and other places; as also the machinery for naval purposes, so fixed as not to be affected by the movement of the vessel.

Collodion Plates.—The following method for preserving the Sensitiveness of Collodion Plates for a considerable time, has been communicated to the *Philosophical Magazine* by John Spiller and William Crookes. "The plate, coated with collodion (that which we employ contains iodide, bromide, and chloride of ammonium, in about equal proportions), is made sensitive by immersion in the ordinary solution of nitrate of silver (30 grains to the ounce), and after remaining there for the usual time, is transferred to a second solution of the following composition:—

Nitrate of zinc (fused)	2 ounces.
Nitrate of silver	35 grains.
Water	6 ounces.

The plate must be left in this bath until the zinc solution has thoroughly penetrated the film (we have found five minutes amply sufficient for this purpose, although a much longer time is of no consequence); it should then be taken out, allowed to drain upright on blotting-paper until all the surface moisture has been absorbed (about half an hour), and then put by until required. The nitrate of zinc, which is still retained on the plate, is sufficient to keep it moist for any length of time, and we see no theoretical or practical reason why its sensitiveness should *not be retained* as long: experiments on this point are in progress; as

present, however, we have only subjected them to the trial of about a week, although at the end of that period they were hardly deteriorated in any appreciable degree. It is not necessary that the exposure in the camera should be immediately followed by the development, as this latter process can be deferred to any convenient opportunity provided it be within the week. Previous to development, the plate should be allowed to remain for a few seconds in the original 30-grain silver bath, then removed and developed with either pyrogallic acid or a protosalt of iron, and afterwards fixed, &c., in the usual manner." The addition of the zinc salt directly to the nitrate bath was not practicable, because the large quantity required rendered the nitrate bath too dense to work with. It is supposed that the addition of a small proportion of nitrate of zinc to the ordinary silver bath, might be useful in hot weather in Photographic rooms.

A Stereoscopic Cosmoramic Lens has been designed by Mr. G. Knight, and exhibited to the British Association. This is a modification of the beautiful instrument invented by Sir David Brewster. The improvement consists in employing, in place of the two small semi-lenses, one large one, which is rendered stereoscopic by cutting an ordinary plano-convex lens in half, removing more or less of the opposite outer diameters, and then transposing the pieces so that the original centre of the lens becomes the two sides, and the outer edges come together in the middle. The advantages obtained by this arrangement is an increased facility for viewing as one the double pictures. Only one adjustment is necessary for all sights—viz., increasing or diminishing the distance between the lens and the double picture.

Production of direct positive Photographic Portraits on Cotton, Linen, Silk, &c. The Messrs. Wulff, of Paris, have presented to the Paris Academy of Sciences a number of photographic portraits taken upon cotton, linen, &c., which are said to be remarkable productions, and not inferior to those produced in any other way. They can be produced in a few seconds, and sold at a very moderate price. The process is still secret, but it is probably done by impregnating the tissue with a solution of collodion containing iodine.—*Comptes Rendus.*

In connexion with these portraits (says the *Journal of Industrial Progress*), we may mention that in the Dublin Exhibition there were several specimens of printed fabrics produced by the action of light, and exhibited by Mr. R. Smith, of Blackford, in Perthshire. These were produced by imbuing the tissue with some sensitive substance, and exposing it to the action of the sunlight, which passed through a plate of glass upon which were pasted pieces of black paper or a negative collodion photograph. The cloth, after sufficient exposure, which is usually about two to twenty minutes, is then removed in order to fix the image. Thus, for example, a white pattern may be produced upon a blue ground by employing solutions of citrate or tartrate of iron and prussiate of potash, the pattern being fixed by washing in a very dilute solution of sulphuric acid; this is a variety of the cyanotype. Brown and chamois may be produced by a solution of bichromate of potash, the excess of the salt upon the parts not acted upon by the light being afterwards washed away, or by washing them with acetate of lead a yellow ground may be formed. The metallic substances thus fixed upon the cloth may then be made to serve as mordants, and all shades of red, yellow, purple, blue, green, &c., produced.

Photographic Printing and Engraving.—Beuviere proposes to obtain copies of letters, &c., by covering a glass plate with a varnish; and then engraving upon the varnish the subject to be copied in the same way as is usually practised for etching. This glass plate is then used as a negative photograph, a sheet of prepared paper being placed behind the glass plate, against which it is evenly pressed by means of a partially filled air-bag. On exposure to the light the paper will be acted upon underneath the parts from which the varnish had been removed by the graver. After sufficient exposure, the letters on the paper are fixed in the usual way. This is simply an application of a process invented by M. Narcisse Salieres, a painter of Montpelier, and described by him under the name of diaphonous engraving, and by which some beautiful photographic etchings have been produced.—*Le Génie Industriel.*

Photolithographic Process.—There has been described to the Société d'Encouragement pour l'Industrie Nationale, at Paris, the following process: An ordinary lithographic stone is taken, and a solution of bitume de Judée (Jew's pitch) is

placed on it. A negative photographic proof is then put on it, and is pressed on the stone for a period which may vary from ten minutes to four or five hours. The page is then washed in pure ether, which soon evaporates. The figure is then found properly marked with its lights and shades, and it may be inked and drawn off as in ordinary lithographs.

Vitrification of Photographs upon Albumenized Glass.—M. Plant has made a very pretty application of photography, which will, no doubt, find many ornamental applications. If a negative photograph upon albuminized glass be exposed to a gradually increasing heat until it becomes red hot, the albumen will be destroyed and the picture will become positive by reflection, and that with a power and brilliancy that is quite remarkable. The picture will be formed by the pure silver, which will adhere with such force to the glass that it may be polished without injury. If the picture in this state be exposed to the action of hydrofluoric acid it will etch the glass wherever it is not protected by the metallic silver; perhaps it would also be possible to strengthen the lines of silver by a further deposition by electrical means, and thus produce a plate from which a matrix might be taken which would yield impressions like an ordinary copper-plate. If instead of heating the glass plate to redness, it be heated until the glass softens, and the surface undergoes semi-liquefaction, the picture will sink into the glass without suffering any injury, and will become covered, to a certain extent, with a varnish of glass; the picture will, so to say, be placed between two surfaces of glass, and thereby lose a portion of its sharpness; nevertheless a very delicate sketch is obtained, which, by using a positive picture, may perhaps serve for church and other ornamental windows, as, without doubt, they would admit of being painted in the ordinary way.—*Moigno's Cosmos; Revue Encyclopédique.*

New Solvent for Collodion.—MM. E. Mathew Plessy and Iwan Schlumberger have proposed wood spirit, or methylic alcohol, as a substitute for ether for dissolving collodion. For this purpose it has many advantages; as it is not so volatile as ether, a thicker and more uniform coat can be applied on glass for photographic purposes. The solution of collodion thus prepared is capable of dissolving a much larger quantity of iodide of potassium than an etherial solution, and will consequently yield a more sensitive coating. The only inconvenience attending the use of wood spirit, and which it is important to notice, is, that during its slow evaporation from the surface of glass, &c., a certain quantity of formic acid is produced. By adding a little alcohol of sp. gr. 40° to the wood spirit and gently warming the glass plate upon which the coating is to be put, the formation of the acid may be obviated. The low price of wood spirit will, we are sure, induce many photographers to test the matter.—*Bulletin de la Société Industrielle de Mulhouse*, No. 212.

Conversion of Photographic Pictures into Engravings.—M. Niépce has succeeded with the aid of M. Lemaitre, in producing engraved steel plates, by the combined application of photography and the chemical means ordinarily used in etching. M. Gillot has since perfected an independent invention, the methods of which are not yet published, by which *any* engraving may be converted into a *raised* block, like a woodcut, so as to be susceptible of being embodied in letter-press in the usual manner. By means of this process, impressions from engravings on steel or copper, obtained by M. Niépce's process, have been reproduced as *raised* engravings, on zinc and other metals, exactly resembling the ordinary metal *clichés*, by which woodcuts are multiplied.

M. Baldus has also made known a method of preparing engravings in relief from photographic impressions, wherein a new agent is most elegantly employed. A copper plate impressed with a photographic image upon bitumen and prepared for etching, as in M. Niépce's process, is attached to the positive pole of a Bunsen's voltaic pile, and placed in a saturated solution of sulphate of copper, with another plate of copper connected with the negative pole. The lines of the image, the parts unprotected by the bitumen, are dissolved out in the voltaic action, and the copper precipitated in the other plate, as in the electrotype process. When the lines are bitten deep enough, the connections with the battery are reversed, and then consequently an electrotype impression *in relief* is deposited upon the original plate. It is requisite that the voltaic action should be very moderate; a deflection of the electrometer amounting to 5° is found sufficient.—Journal of the *Photographic Society*, No. 16.

HOW TO SPLIT A SHEET OF PAPER.

THIS process may be useful to photographers, who often desire to render their paper more transparent and free from stains at the back. It is thus described by Mr. Leighton, in the *Journal of the Photographic Society:*—

The simple way to sever a sheet of paper into halves, consists in placing the leaf about to be divided between two pasted surfaces stronger than itself, drawing the two outsides apart when dry, the centre leaf adhering equally to the two outer papers when drawn asunder.

To divide a photograph or other paper of value, procure two leaves of paper harder than the one about to be split, and slightly tougher; these paste, with clean stiff paste, free from lumps, on either side of your picture—which is also to be pasted—to form, as it were, the centre of a three-sheet cardboard, which must be well rubbed down with the hand to get rid of all air bubbles, being afterwards put aside to dry gently; when dry it will be ready to divide by drawing the two outside leaves in contrary directions, each having half of the centre sheet adhering thereto; these outside papers, with their half-leaf, may now be laid in clean water to soak the paste into a pulp as before, when the thin split sheets can be drawn away, rinsed, blotted to remove moisture, and mounted on card, if required. Care must be taken in starting the severance to be sure that the sheets divide equally; once well off, all will go right.

GALLIC AND TANNIC ACIDS.

PROF. CALVERT has described to the British Association "The Action of Gallic and Tannic Acids on Iron and Alumina Mordants." The author drew the following conclusions from the facts contained in his communication:—1st. That there can be no doubt that tannic acid is the matter in tanning substances which produces black with iron mordants. 2ndly. That the reason of gallic acid producing no black dye is, that it reduces the peroxide of iron in the mordant, forming a colourless and soluble gallate of protoxide of iron. 3rdly. That gallic acid has the property of dissolving hydrate of alumina, and also of separating alumina mordants from the cloth on which they are fixed. 4thly. That the reason of extracts of tanning matter losing their dyeing properties is, that the tannin is transformed into gallic acid. 5thly. That gallic acid possesses the property of dissolving iron, and thus lays claim to the character of a true acid; whilst tannin, not having this action, appears to me to be in reality a neutral substance.

Natural History.

ZOOLOGY.

SPECIFIC DIFFERENCE OF THE HUMAN RACE.

PROFESSOR AGASSIZ'S researches in Embryology possess most important bearings on the Natural History of Mankind. He states, for instance, that, during the fœtal state, it is in most cases impossible to distinguish between the species of a genus; but that, after birth, animals being governed by specific laws, advance each in diverging lines. The dog, wolf, fox, and jackal, for example, the different species of ducks, and even ducks and geese in the fœtal state, cannot be distinguished from each other; but their distinctive characters begin to develope themselves soon after birth. So with the race of men. In the fœtal state there is no criterion whereby to distinguish even the Negro's from the Teuton's anatomical structure; but, after birth, they develope their respective characteristics in diverging lines, irrespective of climatic influences. This he conceives to be a most important law; and it points strongly to *specific* differences.—*Jameson's Journal*, No. 114.

ANTHROPOID APES.

PROFESSOR OWEN has delivered to the British Association a lecture "On the Anthropoid Apes," of which the following is an abstract:—

The Lecturer defined the known species of those large tail-less apes, which form the highest group of their order (Quadrumana), and consequently make the nearest approach to man; he determined the true zoological characters of the known orangs and chimpanzees, as manifested by adult specimens; he pointed out the relative proximity of the orangs and chimpanzees to the human species; and indicated the leading distinctions that separate the most anthropoid of those apes from man. The Professor then entered upon the subject of the varieties of the human species, and defined the degree in which the races differed from each other in colour, stature, and modifications of the skeleton. He proceeded to the consideration of the causes of these varieties, and next examined how far any of the known causes which modify specific characters could have operated so as to produce in the chimpanzees or orangs a nearer approach to the human character than they actually present. He pointed out some characters of the skeleton of the ape, *e. g.*, the great superorbital ridge in the Gorilla Ape, which could not have been produced by the habitual action of muscles, or by any other known influence that, operating upon successive generations, produces change in the forms and proportions of bones. The equable length of the human teeth, the concomitant absence of any interval in the dental series, and of any sexual difference in the development of particular teeth, were affirmed

to be primitive and unalterable specific peculiarities of man. "Teeth," the Professor proceeded to state, "at least such as consist of the ordinary dentine of mammals, are not organized so as to be influenced in their growth by the action of neighbouring muscles; pressure upon their bony sockets may affect the direction of their growth after they are protruded, but not the specific proportions and forms of the crowns of teeth of limited and determinate growth. The crown of the great canine tooth of the male *Troglodytes gorilla* began to be calcified when its diet was precisely the same as in the female, when both sexes derived their sustenance from the mother's milk. Its growth proceeded and was almost completed before the sexual development had advanced so as to establish those differences of habits, of force, of muscular exercise, which afterwards characterise the two sexes. The whole crown of the great canine is, in fact, calcified before it cuts the gum or displaces its small deciduous predecessor; the weapon is prepared prior to the development of the forces by which it is to be wielded; it is therefore a structure foreordained, a predetermined character of the chimpanzee, by which it is made physically superior to man; and one can as little conceive its development to be a result of external stimulus, or as being influenced by the muscular actions, as the development of the stomach, the testes, or the ovaria." The difference in the time of disappearance of the suture separating the premaxillary from the maxillary bone, was not explicable on any of the known causes.

There was not, according to Professor Owen, any other character than those founded upon the developments of bone for the attachment of muscles, which was known to be subject to change through the operation of external causes; nine-tenths, therefore, of the differences, especially those very striking ones manifested by the pelvis and pelvic extremities, which Prof. Owen had cited in his "Memoirs on the Orangs and Chimpanzees," published in the *Zoological Transactions*, as distinguishing the great chimpanzee from the human species, must stand in contravention of the hypothesis of transmutation and progressive development, until the supporters of that hypothesis are enabled to adduce the facts and cases which demonstrate the conditions of the modifications of such characters. There was the same kind of difficulty in accounting for the distinctive characters of the differeht species of the orangs and the chimpanzees, as for those more marked distinctions, that remove both kinds of apes from man. And with regard to the number of the known species, Prof. Owen remarked, it is not without interest to observe, that as the generic forms of the Quadrumana approach the Bimanous order, they are represented by fewer species. The gibbous (Hylobates) scarcely number more than half-a-dozen species; the orangs (Pithacus) have but two species, or at most three; the chimpanzees (Troglodytes) are represented by two species. The unity of the human species is demonstrated by the constancy of those osteological and dental characters to which the attention is more particularly directed in the investigation of the corresponding characters in the higher *Quadrumana*. Man is the sole species of his genus—the sole repre-

sentative of his order: he has no nearer physical relations with the brute-kind than those which arise out of the characters that link together the great group of placental mammalia, called "Unguiculata."

The Professor, in conclusion, briefly recounted the facts at present satisfactorily ascertained respecting the antiquity of the Quadrumana and of man upon the surface of the earth. At the time of the demise of Cuvier, in 1832, no evidence had been obtained of fossil Quadrumana, and the Baron supposed that both these and the Bimana were of very recent introduction. Soon after the loss of that great re-constructor of extinct species, evidence with regard to the fossil Quadrumana was obtained from different quarters. In the oldest (eocene) tertiary deposits in Suffolk, specimens of jaws and teeth were found, that unerringly indicated the former existence of a species of monkey of the genus Macacus (*Macacus cocenus*). About the same time, the tertiary deposits from the Himalayan mountains gave further evidence of the Quadrumana: jaws, astragali, and some other parts of the skeleton, having been found completely petrified, and referable to the genus called Semnopithecus, which is now restricted to the Asiatic Continent. Dr. Lund discovered in Brazil fossil remains of an extinct platyrhine monkey, surpassing any known Cebus or Mycetes in size: the platyrhines are peculiar to South America. Lastly, in the middle tertiary series in the south of France, was discovered a fragment of the lower jaw, proving that at that period some species of the long-armed ape (Hylobates) must have existed. But no fossil human remains have been found in the regularly deposited layers of any of the divisions (not even the pliocene) of the tertiary series. Human bones have been found in doubtful positions, geologically considered, such as deserted mines and caves, in the detritus at the bottom of cliffs; but never in tranquil, undisturbed deposits, participating in the mineral characters of the undoubted fossils of those deposits., The petrified Negro skeletons in the calcareous concretes of Guadaloupe are of comparatively recent origin.

Thus reference to the unity of the human species, and to the fact of man being the latest, as he is the highest, of all animal forms upon our planet, the interpretations of God's Works coincide with what has been revealed to us as to our own origin and zoological relations in His Word. Of the nature of the creative acts by which the successive races of animals were called into being we are ignorant. But this we know, that as the evidence of unity of plan testifies to the oneness of the Creator, so the modifications of the plan for the different modes of existence illustrate the beneficence of the designer. Those structures, moreover, which are at present incomprehensible, as adaptations to a special end, are made comprehensible on a higher principle, and a final purpose is gained in relation to human intelligence; for, in the instances where the analogy of humanly invented machines fails to explain the structure of a divinely created organ, such organ does not exist in vain, if its truer comprehension in relation to the Divine idea lead rational beings to a better conception of their own origin and Creator. The discourse was illustrated by drawings and diagrams of the principal external and osteological

characters of the different species of orangs and chimpanzees, and of the different varieties of the human race.

THE WILD SHEEP AND HUNTING DOGS AT THE ZOOLOGICAL SOCIETY'S GARDENS, REGENT'S-PARK.

THE beautiful specimen of the Indian Wild Sheep (*Ovis Vignei*) is the first which has reached Europe alive, and is, consequently, a most interesting addition to the Society's collection. They are indebted for it to the liberality of Brigadier Hearsey, C.B., who, having had the command of one of our divisions in the Punjaub for some years, has had frequent opportunities of obtaining illustrations of the zoology of that country. This Sheep has a very extensive range in the Himalaya, and forms one of the most exciting objects of the mountain chase. It is far more deer-like than the European moufflon, and when full grown, attains a very considerable size. Its activity, courage, and wariness render it by no means an easy task to secure a numerous bag of these animals; and the Himalayan sportsman has many a mile of valley and hill-top to scour before he can accumulate a first-rate series of trophies. The habits of this Sheep, of the Burrhil, and the gigantic *Ovis Ammon*, are well sketched by Colonel Markham, in his admirable hunting journal of adventures in the Himalaya, where he traced their steps from their first appearance in the hills to the remotest valleys of Cashmir.

The Hunting Dogs (*Lycaon venaticus*) have been reared from a very early age in the Regent's-park. They were, we believe, brought to this country by an officer in her Majesty's service, on his return from the Kaffir war. The vivid colouring, the singular form, and the perpetual vivacity of these animals, make them a special object of interest to visitors.

Every one who has read Gordon Cumming's account of night-hunting in South Africa, will remember how the sagacious "Wilde Honds" hunt up to their game in packs, and how ruthlessly they ravage the flocks of the Boers, when a nobler quarry is not within their reach.

Kind treatment and plenty of food have changed the nature of the Society's specimens, which exhibit marked attachment to their keeper, and allow him to enter their enclosure at all times with no better protection than a switch. The Hunting Dog extends from the Cape northward as far as Abyssinia, and ranges probably for nearly an equal distance on the west coast. Comparatively few examples of this interesting animal are brought to Europe, and the pair which the Society now possess are among the finest we have seen.—*Illustrated London News.*

ARCTIC BIRDS AND FOXES.

A CONSIDERABLE number of valuable Arctic Birds, Foxes, &c., has been received by the Zoological Society from the territories of the Hudson's Bay Company; having been brought in two of the

Company's ships, the *Prince of Wales* and the *Prince Arthur*. The birds consist of three fine specimens of the American Eagle Owl, five rare white Arctic Grouse, one Ruffed Grouse, and a young White-headed Eagle. The varieties of the foxes are the White Arctic, the Red, and the Silver; one specimen of the latter has recently died. Besides ten Foxes, there are two young Black Bears. The whole have been presented to the Zoological Society by Mr. William George Smith, of the Hudson's Bay House, and have been added to the menagerie of the Zoological Society, in the Regent's-park.

GROWTH OF FISH.

WHILST Pisciculture is gaining ground in every country in modern Europe, it may be interesting to our readers to publish certain facts within our own knowledge relative to the increase in size of fish in particular waters in Belgium. The growth of the salmon, as proved by the marked fish of the Duke of Sutherland, in the Scotch fisheries, is notorious, and has already been fully noticed in previous *Year-Books of Facts.* In four months' time, it has been proved that the young fry, between the period of their leaving their native rivers for the sea and their return, have increased in weight, varying from 3 to 7lbs. Without the positive proof of identity by marking, this would have been as it previously had been, chimerical. We have now to notice the increase, in the waters at Boitsfort, near Brussels, of the jack, the only species of fresh-water fish which has as yet been put to the test in regard to its growth. In these waters, in October, 1852, about 2000 were left as stock, none exceeding 2lbs. in weight, the fish thus put in being indigenous to the water; these fish have been caught the present month with rod and line as high as 6lbs. each, showing an excess in weight of 4lbs. in 16 months—a rate only known in the first rivers in England. But the most extraordinary increase has been in the fish not indigenous. In the month of March of last year a fresh supply of jack was put in as stock from a neighbouring water, the largest being 3lbs. in weight; these fish were marked by cutting off a portion of their tail fin. Two of the fish thus marked were caught last week, one weighing 8½lbs., another 7½lbs., thus showing a positive increase as to one of 5½lbs., in a period of 11 months, taking it even upon the assumption that the fish so caught were those weighing the excess of weight of 3lbs. when put in, and of which weight there were but few. We have been informed that in these waters the other description of fish, such as carp, tench, perch, and eels, increase, as to the two former, after the rate of 2lbs. per annum; but this will form the subject of future experiment by marking, which has not been hitherto done. It is generally known that change of water from that in which they have been bred is most productive of profit to fresh-water fish; but it would be incredible, without the proof, that a fish of 3lbs. could add 5½lbs. to its weight within the period of a year. For the information of amateurs in England in the gentle art, the lake in which these jack are is of about 10 acres, supplied with

three continuous streams of water running through it. No fish breed in it but roach, jack, perch, and eels, the coldness of the contributory water stopping all breeding of carp and tench; the supply of the latter being through store fish of from three ounces to half a pound, which, from observations made, increase in the ratio before mentioned.—*Brussels Herald*, *Literary Gazette*, No. 1397.

EXTRAORDINARY FISHES FROM CALIFORNIA.

PROFESSOR L. AGASSIZ having received from Mr. A. C. Jackson, soon after his return from California, the information that, while fishing in San Salita Bay, he had caught with a hook and line a fish of the perch family, *containing living young*. It appears that Mr. Jackson having taken two of these fish, cut the largest of them, to put upon his hook, for change of bait; he intended to take a piece from the thin part of the belly, when he saw coming from the opening thus made *a small live fish*. This he at first supposed to be prey which the fish had swallowed; but on further opening the belly, he found next to the back of the fish, and slightly attached to it, *a long very light violet bag, so clear and so transparent, that he could already distinguish through it the shape, colour, and formation of a multitude of small fish (all fac-similes of each other) with which it was well filled.* Having opened the bag, Mr. Jackson took therefrom *eighteen* more of the young fish, precisely like in size, shape, and colour, the first accidentally extracted. *The mother was very large round her centre, and of a very dark brown colour, approaching about the back and on the fins a black colour, and a remarkably vigorous fish.* The young were in shape, save as to rotundity, perfect miniatures of the mother, formed like her, and of the same general proportions, except that the old one was (probably owing to her pregnancy) much broader and wider between the top of the dorsal and the ventral fins, in proportion to her length, than the young were. *As to colour, they were in all respects like the mother, though the shades were many degrees lighter.* Indeed, they were in all respects like their mother and like each other; the same peculiar mouth, the same position and shape of the fins, and the same eyes and gills; and there cannot remain a single doubt that these young were the offspring of the fish from whose body they were taken, and *that this species of fish gives birth to her young alive and perfectly formed, and adapted to seeking its own livelihood in the water. The number of young in the bag was nineteen, and every one as brisk and lively, and as much at home in a bucket of salt water, as if they had been for months accustomed to the water.*

This statement appeared so extraordinary, that Professor Agassiz requested Mr. Jackson to procure for him specimens of the fish preserved in alcohol; and these being forwarded to Professor Agassiz, after a careful examination of the specimens, he satisfied himself of the complete accuracy of every statement contained in Mr. Jackson's letter, and since ascertained that there are two very distinct species of this remarkable type of fishes among the specimens forwarded to me by *Mr. Cary.* Professor Agassiz proposes for them the generic name of

Embiotoca, in allusion to its very peculiar mode of reproduction. He feels some hesitation in assigning a family name to this type. It is probable that all its members will present the same peculiarity in their mode of reproduction; and that, therefore, the name *Embiotoca* may with perfect propriety be modified into *Embiotocoidæ*, as Didelphis has given its name to a numerous family, the *Didelphyidæ*, after having been for a long time simply a generic name. Should it, however, be found that other types of this family present various modifications in their viviparous reproduction, for which the name *Embiotocoidæ* might be objectionable, Professor Agassiz would propose to frame some family name from another structural peculiarity of these fishes, not yet observed in any others, viz., the naked furrow-like space parallel to the base of the posterior dorsal fin, separating the scales which cover the base of the rays from those of the sides of the body, and name it *Holconoti*. M. Agassiz, in order to commemorate the service thus rendered to zoology, has inscribed the two species now in his museum in Cambridge, labelled *Emb. Jacksoni* and *Emb. Caryi*. A country which furnishes such novelties in our days, bids fair to enrich science with many other unexpected facts, and what is emphatically true of California, is in some measure equally true of all our waters. This ought to stimulate to renewed exertions not only our naturalists, but all the lovers of nature and of science in this country.

For the characteristics of these fish, described by Professor Agassiz, in the *American Journal of Science and Arts*, vol. xxi., see *Jameson's Journal*, No. 114.

HABITS OF CERTAIN CRAW-FISHES.

DR. R. P. STEPHENS says, in a letter to the Smithsonian Institution: "Our friends the *Astaci* increase in interest as I become more and more acquainted with their habits and instincts. I have learned this month that they are migratory, and in their travels are capable of doing much damage to dams and embankments. On the Little Genesse they have, within a few years, compelled the owners of a dam to rebuild it. The former dam was built after the manner of dikes, *i.e.*, with upright posts, supporting sleepers laid inclining at an angle of 4·5° up the stream; on these were laid planks, and the planks covered with dirt. The *Astacus*, proceeding up stream, would burrow under the planks where they rested on the bottom of the stream, removing bushels of dirt and gravel in the course of a night. I have seen this season, where they had attempted the present dam, piles of dirt, of at least one bushel. They now travel over the dam in their migrations, often climbing upright posts, two or three feet high, to gain the pond above."—*American Journal of Science and Arts*, vol. xvii.

COD-FISHING OF THE LOFODDEN ISLANDS.

HERE, chiefly in the inclement months of February and March, fishing-boats, from an extent of coast of several hundreds of miles, are concentrated to the number, it is said, of 3000, manned by

16,000 hardy fishermen, who catch, in the season, not less than 3,000,000 cod-fish; these are chiefly dried without salt, in the sun and wind, a process peculiar to the clear, dry climate of Nordland and Finenarken.—*Forbes on Norway.*

HABITS OF MEDUSÆ AND LITTLE FISHES.

MR. CHARLES W. PEACH, of Wick, Caithness, having read in various works that the larger Medusæ preyed upon fishes for food, was induced to place on record some observations made by himself during the previous year at Peterhead, Aberdeenshire, which had induced him to question the correctness of this statement. The Medusæ seen (which belonged to the species *Cyanea aurita* and *C. capillata*, or *C. inscripta?*) were so immensely abundant, as to render it somewhat difficult for the fishermen to lift their oars from among them. In the first extract (dated Aug. 1, 1853), the author states that he has observed very small fishes playing round the larger Medusæ in the harbour and bay. They were sometimes seen sporting round *C. aurita*, but on the approach of an enemy would instantly leave it for *C. inscripta*. When attacked or alarmed, they would rush under the umbrella, and amongst the tentacula, and remain sheltered in the large folds connected with the ova, till the danger had passed, when they would emerge, and sport and play about their sheltering friend. When beneath the umbrella, they would lie so close, that they were frequently taken into a bucket with the Medusæ, sometimes two or three being captured together in this way. They proved to be young whiting, varying from 1 inch to 2½ inches long. These little creatures, so far from becoming the prey of the Medusæ, evidently experienced from them protection; moreover, they prefer the *stinging* one, with its eight bunches of long tentacles, and large fringed ovaries, to *C. aurita*, with its single and frequently short row of delicate appendages. In no instance did Mr. Peach see a fish in the stomach of the Medusæ, but all could liberate themselves when they pleased. In the second extract, Mr. Peach describes an attack which he witnessed upon a small whiting, in the first instance by a single "baddock" (young pollack), whose assault the little fellow easily evaded by dodging round a small *Cyanea aurita*, but the chaser being joined by others, the whiting was driven from its imperfect shelter, and after being much bitten and dashed about by its assailants, became at length completely exhausted, and lay to all appearance dead. Recovering, however, after a time, it swam slowly to the Medusæ, and took refuge as before; but its movements being soon observed, it was again attacked after a very brief respite, driven into open water, and speedily despatched.—*Proceedings of the Linnæan Society.*

CONCHOLOGY OF JAMAICA.

THERE is, perhaps, no part of the world which stands so pre-eminent in conchological riches as Jamaica; and although only two-thirds of that interesting and beautiful island have been explored, yet upwards of 400 species of land and fluviatile shells have been dis-

covered within the last five or six years. This number is altogether exclusive of the many varieties of the same species which those collectors have added to their cases who have turned their attention and labour to this branch of science. Well arranged and rare specimens of the Jamaica land and fluviatile shells already possess the most honoured places in the noble conchological museum of Amherst College, Massachusetts, United States; and similar suites have been presented to the Ashmolean Museum at Oxford, and to one other of our great public institutions in the United Kingdom. But the most entire and superb suite of land shells which probably was ever collected in any part of the world has been lately deposited in the British Museum, through the munificent liberality and research of the Hon. Edward Chitty, one of the Judges of Jamaica.

ON THE VASCULAR SYSTEM OF THE LOWER ANNULOSA.

BY MR. T. H. HUXLEY.

UNDER the term Lower Annulosa, the author included the Annelida, the Echinodermata, the Trematoda, the Turbellaria and the Rotifera,—in all of which there exists a peculiar system of vessels, which have hitherto been universally regarded as a blood-vascular system. Without considering the view he was about to lay before the Section to be fully demonstrated, the author said, that he had to offer very strong reasons for considering the prevalent notion to be incorrect. The vascular system of the higher Annulosa and of the Mollusca is in all cases a more or less specialized part of the common cavity of the body. The fluid which it contains is a corpusculated fluid; the propulsive organ, if any special heart exist, is a contractile sac, connected by valvular apertures, with that common cavity. Now, although it might be incorrect to say that the vascular system of the lower Annelida is invariably distinguished by characters the opposite of these, still there can be no question that, as a general rule, such is the case; and this circumstance is alone sufficient to raise grave doubts as to the homology of the two systems. But these doubts are greatly strengthened when we take into consideration certain facts, which the author proceeded to lay before the Section. In the Rotifera there is a system of vessels, consisting of a contractile vesicle, opening externally, from which canals, containing long vibratile cilia, pass into the body. In certain Distomata, such as *Aspidogaster conetricula*, there is a system of vessels of essentially similar character; but the principal canals—those lateral trunks which come off directly from the contractile vesicle—present regular rhythmical contractions. The smaller branches are all richly ciliated. In other Distomata the lateral trunks appear to be converted into excretory organs, as they are full of minute granules; they remain eminently contractile; but their connexion with the system of smaller ramified vessels ceases to be easy of demonstration. As Van Beneden and others have shown, they still form one system; but the cilia are no longer to be found in the smaller ramified vessels, having sometimes vanished altogether; at others, being discoverable only here and there in the minute ultimate terminations of these vessels.

In certain Nematoidea the vascular system is reduced to a couple of lateral contractile vessels, altogether devoid of cilia, but communicating, by a small aperture, with the exterior. Now, there is no doubt that in all these cases, the "vascular system" is physiologically a respiratory system; while the common cavity of the body represents the blood-vascular system of the Mollusca and Articulata. However, Echinorhynchus possesses a vascular system of the same nature as that of a Nematoid or Distomatous worm, but presenting no cilia, and having no external opening; thus forming a closed vascular system, homologous with those previously described, and differing from them only in the fact of its closure. But from hence it is a very easy and natural transition to the vascular system of the Annelida; and the author stated his conviction, based not only upon these, but upon many additional reasons, that these so-called blood-vessels and those of the Echinodermata, form, in fact, only the final term of a series, of which the so-called water vascular-system of the Rotifera constitutes the commencement. If, however, these vessels have really nothing to do with the proper blood vascular system of the higher Annulosa, with what system of organs are they homologous? In answer to this question, the author stated his belief, that they correspond with the tracheæ of Insecta, which present a similar extensive ramified distribution; and, in some cases, as in the larvæ of the Libellulidæ, constitute as completely closed a system of vessels.

IDENTITY OF STRUCTURE OF PLANTS AND ANIMALS.

MR. HUXLEY has ascertained that in all the animal tissues, the so-called nucleus (endoplast) is the homologue of the primordial utricle—with nucleus and contents—(endoplast)—of the plant, the other histological elements being invariably modifications of the periplastic substance. Upon this view, we find that all the discrepancies which had appeared to exist between the animal and vegetable structures disappear; and it becomes easy to trace the *absolute identity* of plan in the two,—the differences between them being produced merely by the nature and form of the deposits in, or modifications of, the periplastic substance. In both plants and animals there is but one histological element—the endoplast—which does nothing but grow and vegetatively repeat itself; the other element—the periplastic substance—being the subject of all the chemical and morphological metamorphoses in consequence of which specific tissues arise. The differences between the two kingdoms are mainly—1. That in the plant the endoplast grows, and, as the primordial utricle, attains a large comparative size; while in the animal, the endoplast remains small, the principal bulk of its tissues being formed by the periplastic substance; and 2. In the nature of the chemical changes which take place in the periplastic substance in each case.—*Jameson's Journal*, No. 113.

We are happy to record that the Council of the Royal Society has granted Mr. Huxley 300*l*. from the Government Grant Fund, for the publication of his Zoological investigations.

THE LAC INSECT.

GENERAL BRIGGS has delivered to the Royal Asiatic Society a lecture on the Coccus Lacca, or Lac Insect, and on its properties and uses. The lac of commerce consists of the cells of a small insect, and of a thick gelatinous liquor found therein, which serves the insect as food. The name of lac is derived from a Sanscrit word, signifying literally the number 100,000, but figuratively myriads, and is expressive of the numberless insects composing each community. Naturalists are by no means satisfied with the information we possess concerning this insect, and the Entomological Society have resolved to grant a medal for the best account of it. Red dyes, resembling that of the lac, have long been known in Europe. Pliny speaks of the insect producing the red dye, and the Romans received half their tribute from Spain in the shape of these insects. A similar insect was also known in the north of Italy, in Germany, and in Poland. John Cooke, in 1769, wrote upon the natural history of lac, but the fullest and most accurate of all accounts is that of Dr. Roxburgh. The insects are found upon and are supported by a variety of trees—in short, all plants yielding milk from the tender branches serve them for food. It not unfrequently happens that large trees are entirely destroyed by myriads of these insects settling upon them. The natives of India, in collecting the lac, destroy the insect also; but Europeans, having found that the shells or cells only are valuable, have devised methods for collecting this product without destroying the producers. As first collected, the lac is found encrusted round sticks, and is hence called stick lac, and in this crude state the collectors who gather it in the forests obtain for it from ¼d. to ½d. per pound. When broken up and cleaned from the sticks it is known as raw lac, and when pulverized and separated from the resinous matter it becomes seed lac. Other processes convert it into lump, plate, and shell lac.

In India, as in England, lac is used as a dye for producing a permanent red colour; and is also employed as a pigment and varnish combined, which resists the effects of cold water and does not wear off. It is also used for making sealing-wax, toys, bracelets, chains, and other ornaments, which are scarcely distinguishable in appearance from gold. In the course of the lecture, General Briggs took occasion to state that the lacquer or japanned, goods of China, Japan, Burmah, &c., are not manufactured, as is generally supposed, from the lac insect, but from a vegetable production—a liquor obtained by making incisions into the bark of certain trees. This exudation is of a very poisonous nature, and great care is required in collecting and using it. Most extensive use is made of it in the countries where it is produced; but as it requires to be used soon after it is drawn from the tree, it is not likely to find its way into the London market in a crude state.

THE MASON WASP OF INDIA.

DR. BUIST has communicated to the Linnæan Society an interesting account from personal observation of this insect. The male is about twice the size of the common wasp, and of nearly the same colour, *the slender portion*, which connects the abdomen with the thorax,

being nearly one-eighth of an inch in length, and scarcely thicker than a horse-hair. The female bears no resemblance to the male, being about one-eighth of his size, and of a bright shining bottle-green. Early in October, so soon as the rains are fairly over, the male Mason Wasp begins to build. Selecting for his nest a spot in some quiet corner, he approaches, holding in his fore feet a piece of wet mud, about the size of a pea. He first makes a neat thin ring of about an inch in diameter. To this successive additions are made till the edifice assumes a nearly spherical form. The opening at the top is now contracted like the neck of a bottle, and turned over with a flat lip, an opening being left of about one-eighth of an inch in diameter, and the interior being divided into several compartments. Two or three of these little structures, each taking six or eight hours to finish, are usually built together, and left to dry. So soon as they are firm enough, the female is seen flitting about and dropping a few eggs in each. The male now approaches, bearing a large green caterpillar, about three-quarters of an inch in length, and fully as large as himself. This, in spite of its struggles, is at length thrust through the bottle-neck aperture of the nest, by the inexorable bee, who, after many a pinch and a nip, seems eventually to sting its victim to death. The orifice is then closed with a little ball of mud; more bottles in succession, to the number of eight or ten, are built, provisioned, and sealed up in the same way, and the builder then seems to trouble himself no further about them. Dr. Buist, who has frequently watched these operations at Bombay, has never happened to see the grubs or young bees; but he states that about a fortnight after the nests are finished they are all found to be burst through, when the fragments of the shell and casing of the chrysalis are seen inside.—*Literary Gazette.*

THE ANTS.

Mr. R. Wakefield has communicated to the Linnæan Society a paper "On Some of the Habits of the Ants." Mr. Wakefield, after referring to the opinion formerly entertained, that Ants amass wheat and other grain for their winter store—an opinion relinquished by most modern naturalists, including Huber—proceeds to record some observations made by himself many years ago, and which tend to throw some doubt upon the marvellous stories that have been related of the wisdom and foresight of the "magni formica laboris" "Besides the resemblance of their pupæ to small corn seeds, for which a careless observer might readily mistake them, I myself," says Mr. Wakefield, "have seen the black species, which I suppose to be formica nigra, for days and nights together, industriously dragging to their cells the seeds of the common violet (viola odorata), which, as is well known, continues to ripen its seed long after its period of flowering. I first observed them on the 3rd of July, 1832, conveying these seeds into their retreats for future provision. What could be their object in giving themselves all this labour? That the seeds thus conveyed were those of the violet I am quite sure, for I compared them with seeds in the capsule of a violet. Could they be intended as food for

the aphides during winter?" That ants work all night has long been known; Pliny says only during the full moon, but Mr. Wakefield states, on the authority of his memoranda, that he has seen them at work on the 6th of June at midnight, and again, though the day had been wet and stormy, on the following night at the same hour, without any reference to the full moon. The late Mr. Joshua Milne, of Clapton, once told Mr. Wakefield that a neighbour of his sent for him one morning in February to show him a colony of red ants, which he had turned up while digging in his garden; and mixed with them Mr. Milne distinctly saw many aphides alive, and also some vegetable substance on which they had probably subsisted during the winter. Many persons have observed ants caressing the aphides during the summer for the sake of their honey-dew, but Mr. Wakefield had never before met with any one who had seen them together in their winter retreat.

Mr. Adam White made some remarks on the Eastern ants, and referred to Colonel Sykes's observations on the storing ant of Poonah (atta providens), the correctness of which had been confirmed in most particulars by Mr. Jerdan in an interesting monograph of the East India ants, published in the *Asiatic Journal,* and communicated by Mr. F. Moore to the *Annals of Natural History.*

Mr. John Curtis, F.L.S., has read a paper (accompanied by a highly finished drawing) "On the genus Myrmica and other indigenous ants." The species of ant inhabiting our island were but imperfectly known until very recently, notwithstanding the publication in 1802, of the *Histoire Naturelle des Fourmis* of M. Latreille, who divided the Formicidæ into several families and genera, which he subsequently named. The European forms he divided into two sections, characterized by some peculiarities in the structure of the neck or petiole, by which in Hymenopterous insects the abdomen is attached to the trunk; one section having a single scale, the other two nodules, on the upper surface of the petiole.

Mr. Curtis, having been enabled to clear up some doubts by comparing the species of Myrmica in his own cabinet with the collections in the British Museum containing typical specimens presented by M. Nylander, author of a monograph of the ants of Northern Europe, proposed in the present paper to describe and figure some English Myrmicæ, which are either new or so little known that it appears impossible to identify the species; trusting that the figures which accompany his paper will render some species no longer doubtful.

BEETLES.

Mr. Adam White has exhibited to the Linnæan Society the type specimen of a fine prionidous Beetle (baladeva Walkeri), described by Mr. Waterhouse, from the collection of the late Sir Patrick Walker, of Edinburgh; and closely related to the dorysthenes rostratus, the type specimen of which, described by Fabricius from the cabinet of Sir Joseph Banks, still exists in the collection of the Linnæan Society. Mr. White regretted that he had been unable to attend

the previous meeting of the society, when Mr. Curtis read his valuable paper on the proper position of hypocephalus armatus in the natural arrangement. He thought Mr. Curtis laid too great stress on the tarsal system, which Mr. M'Leay had clearly shown to be very weak when employed alone as a leading character. Indeed, Latreille, the great founder of the tarsal system, in a memorable sentence quoted by M'Leay, had himself admitted its weakness. Mr. White stated that, having for years studied longicorn beetles, he could not but be struck, on first seeing the specimens of hypocephalus in Mr. A. Turner's hands, with the correctness of Dr. Burmeister's determination, and of Mr. Westwood's remarks on its longicorn character. To Mr. Curtis's observation that it was pentanerous, he replied that the parandridæ are all so, and yet are essentially longicorn in their type; that tricteuotoma of Mr. G. R. Gray was heteromerous, and was even sublamellicorn in its antennæ, that insects, and, indeed, animals generally which were fossorial, or internal feeders, or which were aquatic, were often wonderfully similar in external structure.

Mr. White has also exhibited, from the rich collection of Mr. J. A. Turner, of Manchester, a specimen of Hypocephalus armatus, an exceedingly rare, wingless, Prionidous beetle, from Minas Geraes, Brazil; with short horns, crooked fossorial legs, large thorax, and a singular head like that of the mole-cricket. Mr. White made some remarks on aberrant forms, and pointed out the probable habits of Hypocephalus, from its affinity to Dorysthenes, the habits of one species of which have been recorded by M. Delessert; and suggested that many anomalous points in the characters of a particular group of Longicorn beetles, containing the genera Psalidognathus, Prionocalus, &c., might, in all probability, be owing to their living in the ground, and feeding on the roots of trees.

THE EYE-SPOT OF INFUSORIA.

A PAPER has been read to the Linnæan Society by Mr. Arthur Henfrey, entitled "Remarks on the so-called 'Eye-spot' of the *Infusoria* and microscopic *Algæ*." After some preliminary observations on the uncertainty which frequently presents itself as to the real existence of the colours exhibited by microscopic objects, from the decomposition of light which takes place in these minute bodies when placed under high magnifying powers, however carefully corrected, Mr. Henfrey passed to the more immediate object of his communication, which was to direct attention to the doubt existing in his own mind with respect to the nature of the red spot described by Ehrenberg as an "eye" in the *Infusoria*. This object Mr. Henfrey had chiefly observed in the *Unicellular Algæ* and *Zoospores*, and was first led to suspect that the red colour depended on unequal refraction in the cells of *Chlamidomonas Pulvisculus*. In these he had frequently found several red spots in one individual cell, and had further observed that when these spots were brought into a clear and well-defined focus, they appeared as bright colourless granules. Frequently no red spot at all could be found. Finally, he had

recently found that he could bring out the crimson colour most beautifully in the hilum of starch granules. When the lens is a little too far away from the object, the hilum appears like a minute black spot; with the lens brought a little nearer, it comes out as a beautiful crimson spot, exactly like an "eye-spot" in every respect. Adjusting the focus exactly, the hilum is seen as a well-defined bright spot, altogether devoid of any prismatic colour.—*Literary Gazette*, No. 1929.

INTRODUCTION OF SILKWORMS FROM ASSAM INTO MALTA.

COLONEL SIR WILLIAM REID, Governor of Malta, has forwarded to the Society of Arts a communication in which he states that, after many failures, he has received some sound eggs of the Indian Silkworm, the *Bombyx Cynthia*, called by the natives of Assam *Eria*, and which feeds on the leaves of the castor-oil plant. Of the eggs received, about five hundred hatched, and the worms, after having undergone two mutations, appeared to be in a very healthy state, feeding only on the castor-oil plant.

On comparing these specimens, says Sir W. Reid, it will be found that there is little difference between them. We have here in Malta gone through all the operations as practised in Assam, excepting weaving the silk thread into cloth. For this we have not yet a sufficient quantity, but the worms are breeding here faster than we can rear the castor-oil plant. They are now (in October) thriving in the open air; as they consume the leaves of the castor-oil, they travel from plant to plant, feeding upon several, but apparently doing well only on the *Ricinus*.

Mr. Westwood has exhibited to the Entomological Society a sample of the silk of the *Bombyx Cynthia*, which had been sent from Malta, through Dr. Templeton, as a proof that the difficulty of unwinding the cocoons, hitherto found insuperable, could be surmounted. Dr. Templeton also stated in his letter that articles had been made from silk obtained by tearing up the cocoons; and it was anticipated that shortly a good supply would be obtained of this silk, of which the durability was incredible, and that thus a great benefit would arise by the introduction of the cultivation of this valuable article into Europe. Mr. Westwood likewise stated that a parcel of the pupæ in their cocoons, forwarded by Sir W. Reid, had reached him safely, notwithstanding the long journey and the changes of temperature to which they had been subject,—proving what had been observed respecting them at Malta, that the species was very hardy and not likely to be affected by their change from India to Italy. The silk produced by these caterpillars is coarse, but very durable; and the extension of its cultivation and its probable improvement in quality may prove to be of much importance to Europe.

CULTURE OF SILK IN PIEDMONT.

SIG. VINCENZO GRISERI, the first person who has undertaken the rearing of the Bombyx Cynthia worm upon leaves of the castor-oil plant, and the first who introduced it into France, has succeeded in

rearing these worms even upon the castor-oil plants while in the ground and in the open air, in the garden of the Chemical Laboratory at Turin. From this mode of treatment Sig. Griseri discovered that these worms do not suffer from a low temperature, nor from strong winds, nor from continued rain; but on the contrary, he obtained finer and better formed cocoons than those produced by the ordinary method, all which circumstances have been submitted to the Royal Academy.

After the first experiment he published, through the printers Chirio and Mina, the mode of bringing up these worms. In the second experiment he also fully succeeded, and found that the cocoons are superior to those brought from Calcutta and Malta; on which account he came to the conclusion that this new silk-worm, a native of Bengal, has found its own climate in Piedmont.

An experiment is now being made as to the mode of extracting the silk, which has been confided to the care of able throwsters: from some samples already produced, it results that this silk is finer and more elastic than our common silk; further, two more important facts have been communicated by Sig. Griseri: namely, that he has succeeded in feeding these worms exclusively upon willow-leaves and lettuce-leaves, and has obtained cocoons similar to those produced from the leaves of the castor-oil plant.—*Turin Gazette.*

THE VINE WEEVIL.

MR. CURTIS has read to the Linnæan Society a "Note regarding a Weevil of the Vine and its Parasite." The attention of naturalists has long been directed to the subject of the injury sustained by the vineyards in the south of Europe from the attacks of insects. Among the beetles which infest the vines, a Weevil, *Attelabus Betuleti*, Fabr., occasionally does very extensive mischief to those of Burgundy, whilst in England this species is content to feed upon the birch. During his stay at Genoa last June, Mr. Curtis paid a visit to the Botanic Garden there, when his attention was called to the vines trained against the walls, which were attacked by the mildew so prevalent this year through Médoc and the wine-growing countries of France and Italy. Whilst thus engaged, he was surprised to see the leaves of the vines rolled up like cigars, by the agency of the above-mentioned insect. Referring to an elaborate memoir by Dr. Debey, upon *Attelabus Betulæ*, Linn., for a detailed account of the *modus operandi* of the leaf-rolling weevils in general, Mr. Curtis briefly stated that the female weevil cuts the leaf through across the diameter, without dividing the midrib, deposits an egg or two upon the upper surface, then rolls up the lower portion, leaving the upper part untouched, so that it remains green for a considerable period. The *Attelabus Betuleti*, however, seems to differ in its mode of manipulation from most other weevils, rolling up the entire leaf from the base to the tip without any transverse cutting. After this preliminary notice of the habits of the Attelabi, the author proceeded to his more immediate object on the present occasion, viz., to call attention to a memoir by Professor Filippi, of Turin, relative to a minute hymen-

opterous insect whose province it is to keep down the multiplication of the *Attelabus Betuleti*. "This little four-winged fly," says he, "a species of *Pteromalus*, contrives to lay its eggs in those of the weevil, which is not very difficult; but the most extraordinary part of M. Filippi's discovery is that a still smaller insect of the same family deposits an egg in that of the parasite, so that the maggot of the first parasite becomes the food of the second, thus preventing the too rapid increase of the parasite, which possibly might otherwise multiply so greatly that the weevil would be exterminated." At the request of Mr. Curtis, the secretary, Mr. Bennet afterwards translated from the original Italian, and read to the meeting, a portion of Professor Filippi's memoir; from which it appeared that the views attributed to him by Mr. Curtis, and which he had in point of fact entertained in the first instance, had, on further examination, been very considerably modified; he having eventually come to the conclusion that the two larvæ above-described belong to one and the same species, and that they furnish a very remarkable instance of what Steenstrup has called the alternation of generations, the *Pteromalus* not producing in the first instance creatures like itself, but intermediate beings, which are the mothers of other offspring capable of being developed into perfect *Pteromali*. These intermediate beings have received from Steenstrup the name of nurses.—*Literary Gazette*, No. 1929.

VINE DISEASE IN OPORTO.

MR. FORESTER has communicated to the Royal Society a paper "On the Vine Disease in the Port Wine Districts of the Alto-Douro." The author, who has had many years' experience in the port wine districts, states that at Oporto and in the north of Portugal an opinion prevails that the roots and ligneous body of the vines are diseased, that the oidium is the effect, and not the cause of the epidemic; that sporules of the oidium exist in the interior of the vine and about its roots; that the obstruction to the ascent of the sap through the various ducts originates in the roots; that black spots appear in the joints of the branches, indicating that disease exists throughout the body of the vine; that a new fungus has appeared on the vines in the shape of globules, containing carbonic acid; and that although vegetation may continue for awhile, the fruit will not ripen, and the vine will perish within a couple of years from this time. The author then describes the commencement and progress of the vine disease—its eccentric effects, the seasons of 1853 and 1854 in contrast—the irregularity displayed in the fermentation of the wines of 1853 made from diseased grapes, and the little argal they deposited on the sides of the vats during the second fermentation. Drawings which accompanied the paper represented sections of various vines which the author had caused to be rooted up for examination. They showed that the spots in the wood, or the obstructions in the ducts, do not necessarily proceed from the roots, but may be traced to wounds, natural decay, or bad pruning; that of some vines with extremely defective roots, but with perfectly sound trunks, all the fruit was

destroyed; and that from vines unsound, both in root and trunk, the most perfect grapes were gathered. The following is the conclusion to which the author has come with regard to the vine disease, after personally visiting the country and examining the roots and stems of many vines. He conceives that the inclemency of the season in 1853, by checking the circulation of the sap in the vines, produced a predisposition to disease; that as yet the oidium does not appear to have materially affected the roots or ligneous body of the vine; but he agrees with others, that if the fungus continues to germinate in the branches without any remedy being applied, it is only too probable that the vines will eventually perish. During the past thirty-three years he has never seen vines without globules, similar to those which are described as a "new fungus;" the farmers call these globules the "transpiraco da videira" (the perspiration of the vine). In his examination of the vines, he did not meet with the black spots alluded to in the joints of the branches, neither did he perceive that the roots were diseased. The oidium may be propagated by inoculation, and it is worthy of remark that the disease appeared almost simultaneously (although with greater or less intensity) in most parts of the Alto Douro, as well as in other countries, attacking alike the old and the young vines, the sound and the unsound, vines grown in vineyards abroad or in hothouses at home; and believing the oidium to be the cause and not the effect of the disease, he feels convinced that if the germ of the fungus, which is evidently lurking on the old branches, can be destroyed as effectually as it appears to have been destroyed under glass, the vines in the port-wine districts of the Alto-Douro may yet be saved.

DEVELOPMENT OF THE WATER-SNAIL.

MR. JABEZ HOGG,* M.R.C.S., has communicated to the Microscopical Society, his "Observations on the Development and Growth of the Water-Snail." The author observes:—The young animal is early provided with cilia, which surround its tentacles at their extreme edge, and thus enable it to keep up a winding motion in the interior of the egg. These cilia are retained for some time after its birth for the purpose of bringing a supply of nourishment before the gastric teeth are properly matured to enable it to cut the vegetable substances upon which it feeds. It is a very interesting physiological fact, to find that if the young animal be kept in fresh water alone, without vegetable matter of any kind, it retains its cilia, and arrest of development follows; it acquires no gastric teeth, and never attains

* Mr. Hogg is the author of a very acceptable work on *The Microscope: its History, Construction, and Application*, published during the past year. This volume extends to nearly 500 pages, and is illustrated with more than that number of engravings. Such a work was much needed, as an introduction to the use of the instrument, and the study of microscopical science, which is altogether of a much higher character than in the days when *The Wonders of the Microscope* was almost the only popular book upon the subject. The science of Mr. Hogg's new work is brought up to the time of its publication, an indispensable requisite in books of this class; it is, moreover, economical in its cost, as well as sound and ly attractive in its contents.

perfection in form or size. If, at the same time, it be confined within a narrow cell or space, it grows only to such a size as will enable it to move about freely; thus adapting itself to the necessities of its restricted state of existence. The author adds, his specimens were, at the end of six months, alive and well, the cilia were retained around the tentacles in constant activity, whilst other animals of the brood and age placed in a situation favourable to growth had attained their full size, and had produced young, which had grown in three weeks to the size of their elder relations.—For the paper, with illustrations, see the *Transactions of the Microscopical Society of London.*

MICROSCOPICAL DESCRIPTION OF THE PROTOCOCCUS NIVALIS FROM THE ARCTIC REGIONS, BY M. JUSTICE.

THE perfect type of the Protococcus Nivalis, is a globular cyst, varying in size from the $\frac{1}{2500}$th of an inch to the $\frac{1}{1000}$th of an inch in diameter; each cell or cyst having an opening, whose smallest diameter measures only the $\frac{1}{5000}$th part of an inch. This opening is surrounded by marked serrated or indented lines, as though by the expansion and gradual growth of the cell the opening had also been irregularly expanded. The plant, when perfect, resembles the red currant of our gardens; as it decays, the red colouring matter is lost, being gradually superseded by a deep orange, which finally appears to change into a brown, or the cell becomes transparent. In this transparent state, when the cell is broken, the thickness of the enveloping cuticle may be measured; this does not exceed the $\frac{1}{20000}$th part of an inch; and where the opening is preserved, the interior of it becomes of a delicate green colour. Many of the cells exhibit the hexagonal figure instead of being globular; but this is the result of compression, where masses of them have been thrown together. Mingled with the protococcus are fragments of a tissue of reticulated and cellular formation, much resembling some of the infusorial polycystina. So minute are the openings in these, that they do not exceed the $\frac{1}{100000}$th part of an inch in diameter.—*Proceedings of the American Philosophical Society.*

BOTANY.

WARDIAN CASES.

DR. S. H. WARD has communicated to the Royal Institution a paper upon this ingenious adaptation. Dr. Ward first explained that his father was led to employ these air-tight cases for the accommodation of his window-plants, by the following circumstance. He had placed a chrysalis in a bottle with a little damp earth, to watch its progress towards transformation into a moth; a fern and a grass began to vegetate, and continued to show a healthy appearance. Thus, all the requirements of nature were contained within the bottle—air, light, and moisture. Many persons, the Doctor added, had fallen into the error, that Ward's Cases were, or ought to be, hermetically sealed: on the contrary, a change of air is frequently *necessary; this* will imperceptibly occur in the closest made cases,

or they would inevitably burst. The trough to contain the earth may be made of any materials—earthenware, or wood pitched inside; but the best are zinc. Of all, by far the best were stated to be bell-glasses, which are also adapted for cut flowers, which are long preserved in them, as in the case of a Camellia, which, on one occasion, had retained its beauty for nearly a month. To size there are no limits, from an ounce phial even to the Crystal Palace itself. The decay of a healthy plant on transmission to a room in town is effected by the variety of gases, evaporation from dryness of air, frequent and sudden alteration of temperature, deposition of dust, soot, &c., the latter especially inimical; all these were provided against by the glass case; while the moisture which was raised became condensed on the sides of the glass on occasions of change in the external temperature, accumulating and descending to the earth, at the bottom becoming more perfectly aërated, and in a state better adapted for nourishing the plant. So complete is the *routine* in such a little world, in itself independent of external circumstances, that the old bottle sealed up nineteen years since is green with vegetation, though the deposits of confervæ on the inner surface disfigure its appearance. This bottle has had no fresh moisture since first closed. The advantages, besides those of mere ornament, were stated to be great—to the poor man, transportations of plants from one country to another, duration of flowering—to all ranks confined in cities and sick rooms, they were a blessing.

At St. Thomas's Hospital, a subscription has been set on foot to provide cases, and in these the patients found a fruitful source of gratification. Dr. Fortune has sent to this country 250 specimens, out of which 215 have arrived in health. Mr. Ward successfully forwarded to Sydney a variety of English plants in a case that was five months on the passage; on its arrival there the primrose was just blossoming; and this case subsequently returned to England with a collection of Australian plants. The carbonization of the atmosphere by animal respiration, and the restoration of oxygen by vegetation, is a well-known fact, and upon this Dr. Ward claims the merit of suggestions as to sanitary buildings in which vegetation would form a conspicuous feature. In connexion with the restorative nature of the process of vegetation, a taper was put under a bell-glass containing a rose and other flowers, and was extinguished in ten minutes. But after exposing the glass to the sun for about three hours, the taper could be again kept alight for the same period as before. In the same manner, vegetation in water would be found to restore the oxygen, and in consequence it was possible to keep fish in air-tight cases, when vegetation was allowed to accompany them.

To Mr. Ward he said was due the credit of having first introduced a vivarium into a closely-glazed case in 1841, and for having depended for the renovation of the air necessary for the fish contained therein upon the purifying action of associated plants, such as *Pontederia crassipes, Pistia stratiotes, Valisneria spiralis.* Snails for the purpose of removing the confervæ that cover the leaves of *valisneria* and other aquatics, were first recommended in a note in

the number of the *Microscopical Journal* for September, 1841. It was, however, stated that so long ago as 1763, Ledermüller had published, in his *Microscopical Recreations*, a figure of an open-mouthed bottle containing fresh-water zoophytes, associated with duckweed, chara, and other plants. Mrs. Thynne first introduced marine vivaria into London; having brought some living madrepores up to town, in 1846, from Torquay, she placed them in two glass tanks, and at first effected aëration of the water by having it daily taken out and poured in gradually from a height, occasionally sending for fresh sea-water and thoroughly renewing it; after a year or two her madrepores seemed to flag, and then she procured some pieces of rock and shell with living seaweeds attached, and subsequently depended upon the counterbalancing action of these. Dr. Ward entertains hopes that success will ultimately attend the adaptation of the principles in extension to the maintenance or restoration of health to the human frame, although he admits that difficulties would present themselves in the attempt to realize such adaptation.—*Athenæum*, No. 1379.

Dr. Ward has exhibited to the Linnæan Society specimens of a rare British fern (Gymnogramma Ceptophylla), grown in a glass case, from mould taken from its native habitat in the island of Jersey, in September, 1853. This plant, like the Trichomanes, attains a much greater degree of luxuriance in a closed case than in its native soil, and lasts very much longer.

THE NEW WATER-WEED.

ALTHOUGH the obstructions caused in rivers by this remarkable plant have but of late attracted general notice, by their increased extent (particularly during the past year 1854), they appear to have been noticed two years aud a half since. In a letter to the *Cambridge Independent Press*, dated Ely, August 11, 1852, Mr. William Marshall states:—

A remarkable plant has recently made its appearance in the rivers Ouse and Cam; and already abounds to such a degree as not only to impede navigation, but, what is of far more importance in this fen country, threatens to injure our drainage.

It occurs in dense, tangled, submerged masses, of considerable extent, and is so heavy, that when cut, instead of rising to the surface, and floating down to the sea, like other weeds, it sinks to the bottom. It is this property which is likely to make it injurious to drainage. The intruder is so unlike any other water-plant, that it may be at once recognised by its leaves growing *in threes*, round a slender stringy stem. The watermen on the river have already named it "Water-thyme," from a faint general resemblancc which it bears to that plant. That it is new to our rivers here is certain; watermen and fishermen pronounce it to be (as I heard one of them call it the other day) "a furreigner."

In a second communication, Mr. Marshall describes the weed as the *Anacharis alsinastrum* of Mr. C. C. Babington, who so named it in 1848. It was first found in this country in 1842, by Dr. George

Johnston, of Berwick-on-Tweed, in the lake of Dunse Castle, which is situated upon a tributary of the White Adder River, which flows into the Tweed. The discovery was lost sight of, and the interest in it ceased, until the autumn of 1847, when it was again discovered by Miss Kirby, of Lubbenham Lodge, in reservoirs adjoining the Foxton Locks, on the canal near Market Harborough, in Leicestershire. The plants were all females, and were found in considerable abundance, growing "closely matted together." Miss Kirby had not observed it there before, and the reservoirs had been cleaned out two years previously. Mr. Babington next described the plant in the *Annals of Natural History*, for February, 1848, when Dr. Johnston at once recognised it as the plant he had found in the loch at Dunse Castle, and in the following autumn found the plant in two stations in the White Adder River.

The colour of the plant is deep green; the leaves are about half an inch long, by an eighth wide, egg-shaped at the point, and *beset with minute teeth, which cause them to cling.* The stems are *very brittle,* so that, whenever the plant is disturbed, fragments are broken off. Its powers of increase are prodigious, as every fragment is capable of becoming an independent plant, producing roots and stems, and extending itself indefinitely in every direction. Most of our water-plants require, in order to their increase, to be rooted in the bottom or sides of the river or drain in which they are found; but *this* is independent altogether of that condition, and *actually grows as it travels* slowly down the stream, *after being cut.* The specific gravity of it is so nearly that of water, that it is more disposed to sink than float, and the cut masses may be seen under water, either on or near the bottom, rolling over and over like woolpacks, clinging to everything they meet with, and accumulating in great quantities at locks and bridges (hugging the piers of the latter), and grounding in shoal water. Its mode of growth may be seen in still and narrow waters, such as the streams above the mills at Cambridge, where it seems to spring first from the two sides and bottom, meeting at length in the middle, and completely filling up the watercourse, almost to the exclusion of the water. Except in very quiet places, it is not likely to be found in flower. Mr. Marshall met with it at Boswell-hill Pits below Ely. He then enters into a statement of the localities in which this weed has been found, and therefrom deduces the opinion that it is an importation from North America. Mr. Marshall's Letters have been reprinted in a pamphlet published by Pamplin, 45, Frith-street, Soho-square. We quote this abstract from the *Illustrated London News*, No. 904, where the new weed is figured.

NEW SUBSTITUTE FOR THE POTATO.

In the garden of the Horticultural Society, at Chiswick, are growing two plants of a Chinese yam, which is expected to prove an excellent substitute for the Potato. They have been obtained from the Jardin des Plantes at Paris, where they have been made the subject of experiments that leave no doubt that it will become

a plant of real importance in cultivation. "If," says M. Decaisne, who has paid much attention to matters of this kind, "a new plant has a chance of becoming useful in rural economy, it must fulfil certain conditions in the absence of which its cultivation cannot be profitable. In the first place, it must have been domesticated in some measure, and must suit the climate; moreover, it must in a few months go through all the stages of development, so as not to interfere with the ordinary and regular course of cropping; and, finally, its produce must have a market value in one form or another. If the plant is intended for the food of man, it is also indispensable that it shall not offend the tastes or the culinary habits of the persons among whom it is introduced. To this may be added that almost all the old perennial plants of the kitchen garden have been abandoned in favour of annuals, wherever the latter could be found with similar properties. Thus, *lathyrus tuberosus sedum telephium*, &c., have given way before potatoes, spinach, and the like. Now, the Chinese yam satisfies every one of these conditions. It has been domesticated from time immemorial, it is perfectly hardy in this climate (Paris), its root is bulky, rich in nutritive matter, eatable when raw, easily cooked, either by boiling or roasting, and then having no other taste than that of flour (*fécule*). It is as much a ready-made bread as the potato, and it is better than the *batatas*, or sweet potato. Horticulturists should, therefore, provide themselves with the new arrival, and make experiments with it in the different climates and soils of France. If they bring to their task, which is of great public importance, the requisite amount of perseverance and intelligence, I have a firm belief that the potato yam (*igname batatas*) will, like its predecessor the potato, make many a fortune, and more especially alleviate the distress of the lower classes of the people." Such is M. Decaisne's account of this new food plant, which is now in actual cultivation at Chiswick; and, judging from the size of the set from which one of the plants had sprung, it is evident that the tubers have all the requisites for profitable cultivation. One has been planted under glass, the other in the open air, and at present both appear to be thriving equally well. The species has been called *dioscorea batatas*, or the potato yam. It is a climbing plant, bearing considerable resemblance to our common black bryony, and when it is considered how nearly that plant is related to the yams, the probability of our new comer becoming naturalized among us receives support.

ORIGIN OF THE WHEAT-PLANT.

SOME curious botanical facts have been laid before the French Academy relative to the transformation of two grasses, *Ægilops ovata* and the *Ægilops triaristata*. M. Espril Fabre, of Adge, in France, has shown that the above grasses were capable of being the source of all or the greater part of our species of wheat. He first sowed the seed of the *Ovata* in the fall of 1838. In 1839, the plants grew to a height of two feet, and ripened in the middle of July. The ears here and there had one or two grains in them.

The crop was five for one, and the straw was brittle and thin. In 1840, the seed of 1839 produced ears more numerous, and generally each contained a couple of grains of an appearance more like wheat. In 1841, the ears were more like wheat, and each had from two to three grains. The figure of the plant was almost like wheat. In 1842, the fourth year of his experiments, the progress was not so sensible as in the previous year. Many of the plants were attacked by rust. The stalks were like *Ægilops*. The ear gave two or three grains each. In 1843, the stalks grew two feet high. In each ear were two or three well-grown grains, and the straw was stronger. The figure of the plant was like wheat. In the year 1844, all the ears were filled. In 1845, the seventh year, the plant had reached the condition of true wheat. These experiments were made in an inclosure surrounded by high walls. There was no grass inside of it, and no grass raised near the spot. In 1846, he sowed this grain in a field broadcast, and continued it four years. In 1850, the straw was full, straight, over two feet high, and each ear contained two or three dozen grains of perfect wheat. Thus a wild plant, subject to cultivation, changed its entire figure and aspects, and gradually assumed a new character.—*Jameson's Journal*, No. 114.

A NEW INVENTION FOR INCREASING THE PRODUCE OF AUTUMN WHEAT.

M. D'Uecle grounds this discovery upon the fact positively ascertained "by study and repeated experiments"—that Autumn Wheat is not an annual, but biennial, like the beet-root and carrot-class; and he therefore proceeds to develop the alleged biennial properties by a novel plan of planting and treatment, for the increase of the produce. The ground is to be well manured, either before winter or at the beginning of spring, to receive the seed between the 20th of April and the 10th of May, this time being chosen to prevent the chance of blossoming during the year. But the time of sowing may be advanced from year to year; for, if it were not for the present degeneracy of the plant, it might occur now in March. Each grain is sown separately, allowing it a large area of ground, if the soil is rich, but diminishing according to its sterility. It is deposited in rows, in holes, at regular distances 9½ to 23½ inches asunder, in each direction, the holes in one row opposite the spaces in the next. Each hole is to contain four or five grains 2½ inches asunder. When the plants have attained a height of 4 inches, all but the finest one in each group are pulled up, and this single one is then left in till the harvest of the succeeding year. This curious process is stated to increase the produce very greatly.—*Jameson's Journal*, No. 114.

NATAL COFFEE.

A beautiful sample of coffee, grown on a farm near the Umblanga, has been shown. The berries are as large, clean, and full as any we have seen imported. The plants are from Bourbon seed sown not quite three years ago, they have received no great attention, but are growing with remarkable vigour. This is the first year of bearing,

and yet so heavy has been the crop, that several of the branches were borne downwards with the weight. The coffee plant, it is now placed beyond doubt, grows vigorously and bears well in this district, and its rapidly increasing cultivation will, before long, tell on the market.—*D'Urban Mercury*.

"MOUNTAIN PRIDE."

DR. ALEXANDER has presented to the Linnæan Society a dried specimen of the Spathelia simplex of Macfadyen, from Moneague, in the island of Jamaica, where it is known by the name of "Mountain Pride," on account of the extreme beauty of its panicles of bright rose-purple flowers, which form a magnificent pyramid eight feet across, and may be seen from a great distance, towering above the surrounding trees.

RUBIACEÆ.

MR. G. LAWSON has read to the British Association a paper "On the Stipular Glands of Rubiaceæ." The presence of peculiar secretory glands on the interpetiolar stipules of Rubiaceæ was first pointed out by Dr. Weddell, of Paris, a few years ago. Dr. Weddell and other observers have regarded this as a feature of structure strictly limited to that section of the order termed Cinchoneæ, which consists chiefly of arborescent species, and includes the plants yielding cinchona barks; but Mr. Lawson's observations lead to the conclusion that the so-called cinchonaceous glands are equally prevalent in Galieæ, and must, therefore, be regarded as of universal occurrence throughout the order. Several of the most recent writers on systematic botany have elevated the two sections of Rubiaceæ to the rank of separate orders:—a view which, while supported in a remarkably satisfactory manner by the habits of the plants and their geographical distribution, is not sustained by any important structural characters. The discovery of cinchonaceous glands in Galieæ, establishes an unsuspected point of relationship between those two ideally distinct groups of plants, and seems to indicate the propriety of retaining them as well-marked sections of one natural order. The principal structural distinction between the two orders depends upon the theoretical notion adopted of the nature of their foliaceous organs, which has led to the discussion of the subject at different times by De Candolle, Lindley, Bentham, and other distinguished botanists. Instead of endeavouring to reduce a portion of the leaves of Galieæ to stipules, as had been generally done, Mr. Lawson is of opinion that the simplest way of viewing the Rubiaceæ is to regard them all as verticillate-leaved plants, the so-called stipules of Cinchoneæ being evidently reduced leaves.

CALIFORNIAN TREE.

THE *Gardeners' Chronicle* announces the discovery in California of a gigantic coniferous tree, 300 feet high. "This magnificent evergreen tree, from its extraordinary height and large dimensions, may be termed the monarch of the Californian forest. It

inhabits a solitary district on the elevated slopes of the Sierra Nevada, near the head waters of the Stanislau and San Antonio rivers, in lat. 38 N., long. 120 10 W., at an elevation of 5000 feet from the level of the sea. From 80 to 90 trees exist, all within the circuit of a mile, and these varying from 250 feet to 320 feet in height, and from 10 to 20 feet in diameter. Their manner of growth is much like *Sequoi (taxodium) sempervirens;* some are solitary, some are in pairs, while some, and not unfrequently, stand three and four together. A tree recently felled measured about 300 feet in length, with a diameter, including bark, 29 feet 2 inches at 5 feet from the ground; at 18 feet from the ground it was 14 feet 6 inches through; at 100 feet from the ground, 14 feet; and at 200 from the ground, 5 feet 5 inches. The bark is of a pale cinnamon brown, and from 12 to 15 inches in thickness. The branchlets are round, somewhat pendant, and resembling a cypress or juniper. The leaves are pale grass green. Those of the young trees are spreading with a sharp acuminate point. The cones are about 2¼ inches long, and 2 inches across at the thickest part. The trunk of the tree in question was perfectly solid from the sap-wood to the centre; and judging from the number of concentric rings, its age has been estimated at 3000 years. The wood is light, soft, and of a reddish colour, like redwood or *Taxodium sempervirens.* Of this vegetable monster, 21 feet of the bark from the lower part of the trunk, have been put in the natural form in San Francisco for exhibition; it there forms a spacious carpeted room, and contains a piano, with seats for 40 persons. On one occasion 140 children were admitted without inconvenience."

INDIAN DEODAR.

DR. ROYLE, who has lately reported to the Commissioners of Woods and Forests on the value of this and other woods, has exhibited to the Horticultural Society a slab of Deodar timber, 18 feet 6 inches long, 4 feet 6 inches wide, and 4 inches thick, recently imported by the East-India Company for submission to European criticism. The Court of Directors have imported for many years an ample and gratuitous supply of the seeds of this tree. The Deodar is a description of timber ranking, it is said, among the highest of the class of firs and deals, being clean from end to end, massive, free from knots, towards the outside so close-grained that it was difficult to count its rings of growth, and fragrant as sandal wood. Dr. Royle produced a Report from Mr. Wilson Saunders and other gentlemen of Lloyd's, pronouncing it to be well adapted to shipbuilding, ranking between the best kind of larch and hard woods. One of the advantages which planters may look to in the Deodar is rapidity of growth. The Indian slab, although 4 feet 6 inches in diameter, was not more than one hundred and ninety years old. If Deodar wood grows as fast in England as in the north-west of India, the trees would be fit to fell in thirty years, at which time they would be 26 inches in diameter.

Geology and Mineralogy.

SILURIA.

THE great event of the past year in geological science has been the publication of Sir Roderick Murchison's important work, entitled *Siluria*, a most elaborate volume which consists of 523 pages, containing 163 woodcuts, 37 plates, and 2 maps. This is a faithful outline of Sir Roderick's previous labours, with a detailed description and condensed practical popular view of the older sedimentary rocks, and their characteristic organic remains, including all the most recent information on this subject. It is to the protozoic series of former accumulations, and the creatures entombed in them, that Sir Roderick's attention is more particularly directed. Sir Roderick brings out, with very strong and conclusive evidence, that the Silurian System is an independent system, a system that appears to have been formed in various parts of the globe at one and the same time, formed of the same rocks and minerals, and inhabited by the same animals and plants; and Sir Roderick maintains that the animals and plants found in the Silurian strata of the different quarters of the globe are not only analogous, but identical.* We are in want of sufficient data to enable us to say much in regard to the meteorology and hydrology of that early period. The higher temperature, which must have then prevailed all over the globe, appears to have been derived from the internal heat, and not the solar heat. We learn from late palæontological researches, that nearly one hundred species of fossil are common to the lower and upper divisions of the Silurian System. Sir Roderick has established his Silurian System with uncontrovertible evidence in Great Britain and Ireland, Germany, France, Belgium, North America, Spain, Portugal, Sardinia, Cape of Good Hope, Himalaya Mountains, Hindostan, Australia, South America, United States, Falkland Islands, &c.

We quote the above from *Jameson's Journal*, No. 114. One of the latest labours of the lamented Professor Edward Forbes was the production of a brilliant paper upon Sir Roderick Murchison's work, for which see the *Quarterly Review*.

THE MAY-HILL SANDSTONE AND THE PALÆOZOIC SYSTEM OF ENGLAND.

PROF. SEDGWICK thus concludes an elaborate paper in the *Philosophical Magazine*, No. 55:—"Once for all I confidently affirm, that the great Cambrian series is a natural and true series, and that its subdivisions have been rightly named. On the other hand, I contend that the classification and nomenclature of the same series in the scheme of the Government Survey is erroneous and untenable. 1st.

* Such a conclusion cannot be held as correct, until we have acquired more accurate data of the biological character of the different epochs, as well as the local faunæ of the periods.—*Ed. Jameson's Journal*, No. 114.

Because it overlooked the true physical and palæontological base of the Silurian series; 2nd. Because its nomenclature is but an expansion of Silurian names derived from sections which were not true to nature. 3rd. Because no section, within the limits of Siluria, gives us a good older palæozoic type. 4th. Because the nomenclature of the Cambrian series (as given in the Survey) was not deduced from the natural groups; but, on the contrary, the natural groups were so packed as to fall in with a previous (Silurian) nomenclature, which was based on erroneous sections. 5th. Because it introduces two different and incongruous schemes of nomenclature into one system, and consequently involves the nomenclature in most needless geographical contradictions and incongruities. There ought never to have been any controversy on the questions I have been discussing; and since the establishment of the May-Hill Sandstone, there is now at least no shadow of reason for its continuance."

THE BAGSHOT SAND.

MR. C. H. WATSON has read to the Geological Society, a paper "On an Outlier of the Bagshot Sands in the Isle of Sheppey." In traversing the coast of the Island of Sheppey in April, 1848, the author noticed that the blue clay of the cliffs near the East-end Preventive Station passes upwards into an irony-coloured clay, and that this clay is capped by ferruginous sands, which extend for about 1½ miles to the south-east, capping the highest parts of the cliffs. These sands, from their general appearance and position, Mr. Weston referred to the Bagshot Sand series, regarding them as an outlier of that formation, similar to the outliers on the Hampstead and Highgate hills; and, for similar reasons, the author considered that the ferruginous clay constituted the top of the London clay, which, from being a deposit purely aluminous, became first impregnated with an irony precipitate, and then, ceasing to be a clay deposit, passed into the ferruginous and sandy deposit of the Bagshot series; and he referred to somewhat analogous instances of change in the strata of the lias and the oolites.

GLACIERS OF NORTH WALES.

A PAPER has been read to the British Association, "On the Thickness of the Ice of the Ancient Glaciers of North Wales, and other Points bearing on the Glaciation of the Country," by Professor Ramsay. The author stated his belief that there had been two sets of glaciers in North Wales since the ground assumed its present general form. The first was on a very large scale, followed by a slow subsidence of the whole country to the extent of 2300 feet, until only the tops of the highest hills remained uncovered by the sea; and when the mountains again rose, a set of smaller glaciers was formed. The thickness of the ice in existing Swiss glaciers was known to be very great; in the Grindelwald it had been ascertained to amount to 700 feet, and in other instances was probably thicker. The observations of Agassiz and Professor James Forbes on the height to which grooved and polished surfaces upon

up the sides of Alpine valleys, had led to the conclusion, that the ice had once been much more extensive; and that in the glacier of the Aar, for example, it must have amounted to 2000 feet. The same method of observation had been applied to North Wales; and it had been ascertained that in the Pass of Llanberris the grooves and roundings of the rocks extended to a height of 1300 feet above the present bottom of the valley. The drifted deposits which overlie these rounded surfaces must have formed during the slow depression which followed, and the glaciers must still have existed, since these deposits, though marine, are still of a moraine character. The cold climate continued during the period of depression, and for some time after it; and there was beautiful evidence in the side valleys of the gradual decrease of the glaciers until they died away amongst the higher mountains, in the form of moraines stretching across the valleys, one within the other. The scratches made by the first set of glaciers passed down the valleys; those of the smaller glac.ers crossed the first obliquely.

LONDON CLAY.

MR. J. PRESTWICH, Jun. has read to the Geological Society a paper "On the Thickness of the London Clay; on the relative Position of the Beds in some of the best known fossiliferous Localities; and on the occurrence of Bagshot Sands on the London Clay in the Isle of Sheppey." Taking such lines of section as afford a definite upper horizon of the London Clay, viz., that obtained by the super-position of the Bagshot Sands as at Wimbledon, Hampstead, High Beach, Rayleigh, Sheppey, &c.), and ascertaining the base of the London Clay, all practicable, by means of well-sections, Mr. Prestwich finds that at Alum Bay, Isle of Wight, the London Clay is 193 feet thick; at Whitecliff Bay, 367 feet; Southampton, 320 feet; in the vicinity of Hungerford and Newbury, from 200 to 250 feet; at Odiham, 330 feet; Reading and Wokingham, 370 to 400 feet; Chobham and near Windsor, about 400 feet; at Hampstead, 420 feet; Wimbledon and High Beach, about 430 feet (not 530 and 700, as stated by Conybeare and Phillips); Rayleigh, 420 feet; and in the Isle of Sheppey, about 480 feet.

By means of several sections and a careful stratigraphical planning, at the same time allowing for the different levels of the several parts of the districts, and comparing the numerous well-sections, the author showed that the London Clay gradually expands as it ranges from east to west: at first very rapidly, until it attains a thickness of from 300 to 400 feet, and then very gradually, until, about London, it averages from 400 to 430 feet in thickness. In Sheppey and on the opposite Essex coast it reaches its greatest development, as much as 470 to 480 feet. Mr. Prestwich observed, that with regard to this apparently regular development, the London Clay was not spread over a previously denuded land-surface, but was a continuation of a series of marine and estuarine deposits which had *already filled* up the irregularities of the old chalk surface. In

Sheppey, Mr. Prestwich met with a thick bed of yellow sand on a hill to the east of Minster, and on the cliffs between East End and Ramsey. This sand the author refers to the lower part of the Lower Bagshot series; and, as the fossil fruits and plant remains of Sheppey are chiefly derived from the clays just beneath these sands, it appears that this singular fossil Flora belongs mainly to some of the uppermost beds of the London Clay; probably to the first 50 or 60 feet. From the absence of these highest beds at Southend, the fossil fruits are much scarcer there than at Sheppey, whilst shells and crustacea abound; the clays of the Southend cliffs corresponding to those of the lower part only of the cliffs at Sheppey, and belonging to the uppermost zone, which is also found at Brentwood. The Highgate fossils belong to the second zone of the London Clay; they occur chiefly near the level of the road at the Archway, in beds of sandy clay. This zone is marked also at Clewer's Green, between Basingstoke and Reading, and at Margaretting Street, near Chelmsford. The Chalk Farm, Primrose Hill, and Copenhagen Fields fossils form another and lower zone, and are, on the whole, deep-sea forms. To the west, however, probably the depth of water was less. The Harwich and Bognor group of fossils, which, however, differ in their conditions of sea-depths, belong to the lowest part of the London Clay, as well as the beds at Potter's Bar, and at Cuffell, near Basingstoke. At Alum Bay, where the London Clay is not so thick, its palæontological divisions are less marked, and similar fossils are generally prevalent throughout its thickness. In the London district each zone is marked by a few distinct species of organic remains, forming distinct, but nearly-related groups, although many species range throughout the four zones, in varying proportions. In the lowest zone, deep-sea forms prevail in the eastern area, and are replaced by shallower water species to the west. The same occurs in the third zone. The second zone has a profusion of species belonging to waters of moderate depth; and in the first or uppermost zone (or, perhaps, superadded beds of the eastern area) occur the great bulk of the remains of reptiles and fishes, and of plant remains.—*Athenæum*, No. 1390.

NATURAL DEPOSIT OF SALTPETRE.

Professor W. H. Ellet, of the United States, reports that there has been discovered in Bradford County, Pennsylvania, a regular vein of Nitre, believed to be unique in its character. The nitre occurs as a solid and uncrystalline deposit in the horizontal seams of a sandstone rock, and in veins proceeding from them at different angles; and the rock itself, which is quite porous, is abundantly charged with the same material. The nitre itself is very pure, containing more traces of nitrate of lime and magnesia. The sandstone in which it occurs is siliceous, containing a little carbonate of lime, and a notable quantity of silicate of potash.—*The Dublin Monthly Journal of Industrial Progress*, No. 8.

ARTIFICIAL FORMATION OF MINERALS BY IGNEOUS ACTION.

PROFESSOR HAUSMANN, of Göttingen, has recently published a memoir on the formation of Minerals in and about furnaces, by furnace action. He enumerates the following varieties observed by him: silver, lead, copper, iron, bismuth, lead-glance, blende, oxide of zinc, red copper ore, iron-glance, magnetic iron-ore, chrysolite, pyroxene containing alumina, Humboldtite, orthoclase, lead-vitriol, and arseniate of nickel. Brown, yellow, green, and black blende were observed formed in the furnaces of Lauten Valley, Hartz, in regular octahedrons and dodecahedrons; also in lamellar and radiated concretions. Lead-glance, he says, is often formed by sublimations in the chimneys of furnaces, and the crystals are cubical with the usual cleavage; crystals of magnetic iron also sometimes incrust cavities in the stone or brick work of the furnaces.—*Jameson's Journal*, No. 114.

USE OF THE MICROSCOPE TO MINERALOGISTS.

M. DUFOUR has made an important microscopical discovery that will be found useful in many circumstances. He has shown that an imponderable quantity of a substance can be crystallized, and that the crystals so obtained are quite characteristic of the substances. For example, he crystallized imponderable quantities of sugar, chloride of sodium, of arsenic, and of mercury, and the crystals obtained were quite characteristic of these substances. The mineralogist and toxicologist may find this process extremely valuable when the substance for examination is too small to be submitted to tests.—*L'Institut*, No. 1067.

THE QUANTITY OF SOLID MATTER CARRIED ANNUALLY TO THE SEA.

MR. A. TAYLOR, in endeavouring to calculate the probable quantity of Solid Matter carried annually to the Sea, either in a state of suspension or in a state of solution, by rivers or rivulets, or by other agents, has arrived at the conclusion that this quantity of sediment spread on the bottom of the sea, is capable of displacing sufficient water to raise the level of the ocean three inches in 10,000 years. This is an important statement, and ought to be borne in mind, when calculating on the changes that our earth has undergone during its formation. He has also calculated that the denudation of sediment over 100,000 square miles of North America, spread by the Mississippi, ought, if its river had always been charged with sediment as it has always been in our days, to have lowered the surface of the earth one foot in 9000 years; and that the Ganges produced the same effect in its hydrographic basin in 1794 years.—*L'Institut*, No. 1067.

M. FUCHS ON IRON.

M. FUCHS is of opinion that iron is a *dimorphous substance*, presenting itself under two distinct general forms or systems of crystallization, viz., the *tesseral* and the *rhombohedral* (or its modification, the *hexagonal*); and, consequently, there may be said to be two *classification species* of iron, which may be distinguished as tesseral

and rhombohedral iron, and which are sometimes combined in different proportions. M. Fuchs's experiments have proved decisively, that the malleable or bar iron belongs to the tesseral crystallization form; and it may be conjectured that all the malleable metals may be classed under that system of crystallization. The crystallization system of pig-iron is not so exactly determined; but it is very likely that it belongs to the rhombohedral system, because facette iron, particularly, is one of the most brittle metals which generally belong to the rhombohedral form. The difference between bar and facette iron is based not only on the difference of the system of crystallization, but also in the great difference between their physical and chemical properties; such as the tendency of the molecules of metal to burst and become displaced; hardness, liability to oxidation, solubility, fusibility:* M. Fuchs is of opinion, that steel is an alloy of tesseral and rhombohedral iron; and he thinks that hardening and tempering consists only in the transformation of all the molecules, or a portion of them, from one system of crystallization to the other,—the rhombohedral iron being predominant in hardened steel, and the tesseral in non-hardened steel.—*Poggendorf's Annalen: Jameson's Journal*, No. 113.

ARTIFICIAL MALACHITE.

ROSE, of Berlin, by the following process, has succeeded in making Artificial Malachite, identical in composition with the natural green malachite. Precipitate a solution of sulphate of copper in the cold bicarbonate of soda or of potash; allow the precipitate, which is voluminous at first, to cohere; finally dry it, and wash it. By polishing, the characteristic appearance of malachite may be brought out.—*Jameson's Journal*, No. 113.

DEPTH OF THE PRIMEVAL SEAS, AFFORDED BY THE REMAINS OF COLOUR IN FOSSIL TESTACEA.

THE late Professor Edward Forbes, F.R.S., when engaged in the investigation of the bathymetrical distribution of existing molluscs, found that not only the colour of their shells ceased to be strongly marked at considerable depths, but also that well-defined patterns were, with very few and slight exceptions, presented only by testacea inhabiting the littoral, circumlittoral, and median zones. In the Mediterranean, only one in eighteen of the shells taken from below 100 fathoms exhibited any markings of colour, and even the few that did so were questionable inhabitants of those depths. Between 35 and 55 fathoms, the proportion of marked to plain shells was rather less than one in three; and between the margin and 2 fathoms the striped or mottled species exceeded one-half of the total number.

In our own seas, the author observes that testacea taken from below 100 fathoms, even when they were individuals of species vividly striped or banded in shallower zones, are quite white or colourless. Between 60 and 80 fathoms, striping and banding are rarely presented by our shells, especially in the northern provinces;

* *Wohler* has already directed his attention to the fact, that every dimorphous *substance* has two different degrees of fusibility.

and from 50 fathoms shallow bands, colours, and patterns are well marked.

The relation of these arrangements of colour to the degrees of light penetrating the different zones of depth, is a subject well worthy of minute inquiry, and has not been investigated by natural philosophers.—*Proceedings of the Royal Society.*

AGE OF OUR PLANET.

It is supposed that the plants of the coal period required a temperature of 22° Reaumur. The mean now is 8°, or 14° less. By experiments on the rate of cooling of lavas and melted basalt, it is calculated that 9,000,000 of years are required in the earth to lose 14° Reaumur.

M. Hibert puts the period at 5,000,000. But supposing the whole to have been in a molten state, the time that must have elapsed in passing from a liquid to a solid state is fixed at 350,000,000 years.—*Ami Boué*: *Jameson's Journal,* No. 113.

DISCOVERY OF MICROSCOPIC SHELLS IN THE LOWER SILURIAN ROCKS.

A paper on this discovery by Professor Ehrenberg, has been communicated to the British Association by Mr. Leonard Horner. The minute grains of greensand, which are characteristic of many rocks, have a different nature from the green earth often met with in concretionary masses. The former, from the *glauconie* of the Paris *calcaire grossier* to the azoic greensand, near Petersburgh, appears to consist of green opalescent casts of Polythalamia, composed of a hydro-silicate of iron. The cretaceous greensands of England contain, unmistakeably, these stony casts. In the *calcaire grossier* and nummulite limestones occur beautifully preserved and perfect examples of Quinqueloculina, Rotalia, Textularia, Grammostona, and Alverlina. In the Lower Silurian greensands, casts of detached cells of Textularia and Nodosaria were found. Professor Forbes said that Mr. Sorby had discovered Foraminifera in the Aymatry limestone; but as some of the beds with green grains were of freshwater origin, it was almost impossible that all greensand should be derived from this source. Professor Sedgwick pointed out instances in which the green colour was due to particles of chlorite. Sir R. I. Murchison stated that the whole group of Lower Silurian strata existed near Petersburgh, though only 1000 feet thick: the upper part, representing the Bala limestone, was 50 to 80 feet thick; next came a sandy bed, with green grains; then brown sandstone with oboli; and lowest of all, shale, with green grains, and crustaceans, once supposed to be fishes, in which it appeared that Professor Ehrenberg had discovered true Foraminifera. Mr. A. Brysson said he had sometimes obtained the silicious shields of Diatomaceæ from boulder clay by means of a fine sieve, when other means had failed, because these objects adhered to the minute particles of mica.—*Athenæum*, No. 1408.

GOLD IN SOUTH AFRICA.

MR. R. N. RUBIDGE has communicated to the Geological Society a paper "On the Occurrence of Gold in South Africa." A wide region in South Africa, to the north of lat. 33° 30′ and three times the extent of the British Isles, is occupied by horizontal fossiliferous strata, characterised chiefly by the remains of extinct reptiles (Dicynodon) and vegetable remains. These strata were first described by Mr. Bain: they are chiefly sandstones, with calcareous nodules; the latter often enveloping the fossil bones. This formation is everywhere intersected by dykes and veins of igneous rock (basalt and Syenite), which are mainly vertical, and vary from one foot in thickness to some hundreds of yards. They frequently protrude along mountain ridges; and the basalt also overlies the surface, forming the cappings of hills and plateaux. The strata are but slightly disturbed, and not much altered; and that only close to the dykes. Iron and manganese occur in the dykes and the strata. Some small nuggets of gold having been found near Smithfield (on the Caledon), in the Orange River Sovereignty (about lat. 30° 10′), Mr. Rubidge and Mr. Paterson were sent to report on the subject. They found that the gold had been met with in two dykes, running north and south, parallel to each other, and about a mile and a half apart; and also in the gravel of the shallow valley between the dykes. These dykes contain some quartz veins, in the cavities of which the gold was discovered, but in small quantity. A fragment of calcareous rock entangled in the trap-dyke was also found to contain a little gold. At Kraai River, near Aliwal, on the Orange River (40 miles south-east of Smithfield), gold was found in quartz surrounding a mass of calcareous sandstone in the trap-rock. The gold from Kroomberg was also found in a dyke. Mr. Rubidge considers that the supply of gold is very limited, its source being the quartz veins in the trap-rocks; and that the gold in the gravel above referred to was not brought from a distance, but derived from the decomposed trap-dykes of the vicinity. The author notices that, as far as his observations went, he found the gold-bearing dykes to have a north and south or meridional direction. He finds it difficult to classify the trap-dykes of this region, but considers the north and south dykes, which form the centres of many ranges of hill and mountain, to be the most ancient; they are crossed by a set of dykes having mainly a north-east and south-west direction. Mr. Rubidge describes also a band of anthracite, between Aliwal and the Stormbergen, which becomes converted into plumbago by contact with the igneous rocks; and he notices the occurrence of agates in the Orange and Sunday Rivers.

GOLD REGIONS OF CALIFORNIA.

MR. WILSON, a practical miner, who has explored, during three years, some of the richest auriferous tracts of California, has laid before the Geological Society a map and sections of these gold regions. The Sierra Nevada is of granite, and rises 5000 feet above the sea; it is flanked on the west by parallel bands of schistose

crystalline rocks (gneiss, limestone, and micaceous, chloritic, and argillaceous slates), striking north-west and south-east, nearly vertical, close to the granite, and dipping somewhat to the east, in the outer parallel. A fossil shell, like an Orthis, was found in the chloritic slate. Mere rocks form a tract about fifty miles in breadth, and averaging about 4000 feet in elevation above the sea. It is traversed by three great veins of auriferous quartz, parallel to the schists and to each other. Between this district and the coast are wide plains of tertiary deposits, extending on either side of the coast range, which runs in a direction parallel to the coast and the Sierra. The coast-range is about 2500 feet high, and is formed of clay-slate, with a westerly dip. The clays, gravels, and boulder-beds in the ravines and plains of the high ground traversed by the above-mentioned quartz-veins, contain gold more or less abundantly, and appear to have been formed under various conditions, by superficial decomposition of the rocks, by landslips, and by detrition and transport through aqueous agency. Calcareous deposits, also, of late tertiary date, covering the gold-drift, embedding boulders and sand, and in the upper part commingled with volcanic cinders, occur extensively in some of the valleys and on the sides of the hills of this elevated region. The largest of the three quartz-veins has itself been worked for gold at Carson's Hill, at the Mariposa R., and the Aqua Frio, and another of the veins at Sonora. The gold was found in the *upper* part of the veins, a circumstance which the author found to obtain in the quartz-veins generally. Quartz-mining, however, on account of the uppermost and richest portions of the veins having already been decomposed and worn away, is not found to be so productive as the generality of the "diggins." Mr. Wilson described several of the gold diggings of the district, especially near Sonora, on the Rivers Stanislaus and Tolumne, and at Mormons', Curtis's, and Murphy's Creeks, &c.; and he pointed out the peculiarities of "river-diggings," "flat-diggings," and "dry-diggings." The search for gold in the beds of the existing rivers has, with few exceptions, proved to be unsuccessful in California. Mr. Wilson described also in detail the porphyry of Table Mountain, the greenstone-vein near Sullivan's Camp, the caves in the tertiary limestone at Coyote Creek, and the Cinnabar mines in the clay-slate, with quartz-veins, of the coast range.—*Athenæum*, No. 1490.

GOLD IN NEW ZEALAND.

MR. C. HEAPHY has read to the Geological Society a paper "On the Gold-bearing District of Coromandel, New Zealand." The mountain ridge of Coromandel is mainly composed of crystalline rocks. Granite forms the summit of the main ridge, and bluish grey slates flank the sides. Trap and quartz veins are very prevalent, and indications of copper, iron, and silver are frequent. A granitic rock appears also on the western coast, about five miles from the main ridge, associated with clay-slate. On the eastern side of the peninsula, a mass of indurated pumice sand flanks the older rocks at Mercury Bay. To the westward, at a distance of thirty miles

(across the Thames Frith, and with some clay-slate islands intervening), is the volcanic district of Auckland. Gold in varying quantities exists in the beds of many of the streams of the peninsula, and in the clay on the slopes and spurs of the chief mountain range. On its western side, the valley of the Kapanga (especially its upper part), the Mataawai (running into the Waian stream), the Karaka stream, the granite coast of Otaki, and the Mauria Creek, have yielded gold; and on the eastern side, the Arataonga and Makiran valleys. The mountains of the Thames, a continuation of the same range, are also auriferous. The highest summit of the Coromandel range is about 3000 feet above the sea; the average height of the range above the diggings is 1500 feet. The author describes in detail the various conditions under which the gold occurs in the alluvial deposits, both in the fragments of its quartz matrix, and scattered through the clay and sand. The matrix has not, however, yet been detected *in situ*. From Mr. Swainson's notice of the Coromandel gold district, it appears that the granite is flanked by vertical schists, and the range is skirted by conglomerates; that volcanic rocks abound in the district; and that the auriferous detritus contains quartz blocks, and fragments of granite, slate, and trap-rock.

MINERAL PRODUCE OF GREAT BRITAIN.

Mr. Robert Hunt, Keeper of the Mining Records at the Museum of Practical Geology, has directed the preparation of some valuable statistics of Mineral Produce and Mining Industry. We regret that we have only space to quote the general results:—The mines from which the largest quantity of ore was produced in 1852 in Cornwall were—Copper: Devon Great Consols, 20,802 tons; United Mines, 10,233; Huel Buller, 9310; Tincroft, 9559; Cambrea, 6616; Par Consols, 5692; Huel Basset, 5966; Huel Seton, 5286; North Pool, 5196; Fowey Consols, 4622 tons, &c. The largest producing tin mines are—Balleswidden, 405 tons; Great Polgooth, 355 tons; and Bolberro, 222 tons. The mine from which (in Cornwall) the largest quantity of lead was produced in 1852 was the East Huel Rose, the yield being—ore, 2381 tons; lead, 1607 tons; silver, 48,000 ounces. The Tamar and South Tamar Consols were the most productive of the Devon mines, the produce being 1869 tons of ore, 1126 tons of lead, and 81,500 ounces of silver. The mine from which the largest quantity was extracted of any in the country is the East and West Allendale and Weardale Mine in Durham; the ore produced being 13,840 tons, and lead, 10,313 tons. In Derbyshire, the Eyam Mines yielded 8338 tons of ore, and 5383 tons of lead; and the Arkendale Mines of Yorkshire, 4765 tons of ore, and 3240 tons of lead.

GROWTH OF LAND SHELLS.

Mr. E. J. Lowe, by a series of experiments upon several species of Shells, has arrived at these facts:—

1st. The shells of Helicidæ increase but little for a considerable period, never arriving at maturity before the animal has once become dormant.

. Shells do not grow whilst the animal itself remains dormant.
The growth of shells is very rapid when it does take place.
Most species bury themselves in the ground to increase the
sions of their shells.—*Proceedings of the Royal Society.*

ITIVE DIVERSITY AND NUMBER OF ANIMALS IN GEOLOGICAL TIMES.

: facts and data in this sound, philosophical, and analytical of Professor Agassiz, in a great measure disprove the notion ained by naturalists and geologists, that genera and species of ls and plants are greatly more numerous at the present age of orld than in any previous geological period; and this he clearly holds good in the distribution of the animal and vegetable oms throughout the earth's orbit, with one or two exceptions. e chronological list of fossils is to him of very little importance, nparison to a good typographical description of the species. ows the necessity of acquiring a knowledge not only of the l biological character of the epoch, but also of the local fauna 1 period. Agassiz states that our present list of fossils teems hronological errors of the worst kind, arising from false identi-ns of strata. This we can well imagine, because our mineralo-geologically speaking), stratigraphical, and petralogical know-is extremely vague. Agassiz further shows in this paper that umber of false identifications of organic remains that have ulated in zoological works are truly frightful; he maintains he materials thus accumulated are no longer fit to be used discussion of the questions that have been raised with the n professors of geology, and that a thorough revision of all the ications of species is required,—and shows that without a te knowledge of species, it is a hopeless task to attempt to ine the order of succession of the fossils in different geological ions.

concludes this valuable paper with some important remarks on sputed question of the period of appearance of dicotyledonous in the geological science. He maintains that the dicotyle-are inferior to the monocotyledonæ, and that there exists a gradation of types in the vegetable as in the animal kingdoms. *Jameson's Journal*, No. 114, which contains the entire paper.) fessor Agassiz, in conclusion, observes: "The very fact that stratified rocks, even among the oldest formations, are almost y made up of fragments of organized beings, should long ago atisfied the most sceptical that both *animal and vegetable life active and profusely scattered upon the whole globe, at all times uring all geological periods, as it is now.* No coral reef in the contains a larger amount of organic debris than some of the ne deposits of the tertiary, of the cretaceous, or of the oolitic, ven of the palæozoic period, and the whole vegetable carpet ng the present surface of the globe, even if we were to consider e most luxurious vegetation of the tropics, and leave entirely consideration the whole expanse of the ocean, as well as those *of land* where under less favourable circumstances the growth

of plants is more reduced, would not form one single seam of workable coal to be compared to the many thick beds contained in the rocks of the Carboniferous period alone."

EDUCATIONAL GEOLOGY AT THE CRYSTAL PALACE.

A PAPER has been read to the Society of Arts "On Visual Education as applied to Geology, illustrated by Diagrams and Models of the Geological Restoration at the Crystal Palace," by Mr. B. W. Hawkins.

To the great majority of the public these restorations will present all the novelty of a first acquaintance, and even many students in geology have hitherto been unable to realize the true form and size of those extinct animals, with the names of which they might however be perfectly familiar. In late years fossils have revealed remarkable facts concerning the state of the globe at divers epochs; and an inspection of the various strata in which remains have been deposited, served to show that, in general, a constant order had obtained in their formation. The author next went on to explain a diagram exhibiting a view of the succession of epochs, each epoch containing a succession of periods and formations,—which, though often found to have been disturbed by some vast convulsive force, could yet be retraced to its natural order of succession and super-position. The extraordinary inhabitants of the new red sandstone, of the lias, of the upper portion of the lias, sometimes known as the alum shale, so well developed at Whitby, and of the oolite, were then severally described; and it was shown how by induction Professor Owen, our British Cuvier, had been enabled to unite together detached fossils so as to form complete animals. In the Crystal Palace restorations, sketch-models to scale, either a sixth or a twelfth of the natural size, were first made; and such attitudes were given to them as Mr. Waterhouse Hawkins's long acquaintance with the recent and living forms of the animal kingdom enabled him to adapt to the extinct species he was endeavouring to restore. Clay models built of the natural size by measurement from the sketch models were then made, and when they approximated the true form, the author in every instance secured the anatomical details and the characteristic features of each specimen. Some of these models contained thirty tons of clay, which had to be supported on four legs, as their natural history characteristics would not allow of recourse being had to any of the expedients for support allowed to sculptors in ordinary cases. In the instance of the Iguanodon, this was no less than building a house upon four columns, as the quantities of material of which the standing Iguanodon is composed consist of 4 iron columns, 9 feet long by 7 inches diameter, 600 bricks, 650 5-inch half-round drain-tiles, 900 plain tiles, 38 casks of cement, 90 casks of broken stone, making a total of 640 bushels of artificial stone. This, with 100 feet of iron hooping, and 20 feet of cube inch bar, constituted the bones, sinews and muscles of this large model,—the largest of which there was any record of a casting having been made.—*Athenæum*, No. 1836.

FOSSILS FROM THE PURBECK BEDS.

PROFESSOR OWEN has read to the Geological Society a paper "On some Fossil Mammalia and Reptilia from the Purbeck Beds at Swanage." Professor Owen gave a detailed account of some remains of small mammalian and reptilian animals found at Durdlestone Bay, near Swanage, Dorsetshire, and previously undescribed. The fossils were lately transmitted for the Professor's examination by Mr. W. R. Brodie and Mr. Willcox, of Swanage. The following are the genera and species established on these specimens:—1. *Nothetes destructor* (Owen), founded on a portion of the left ramus of the lower jaw, with seven teeth, of a small pleurodont lizard, allied to the Monitors of the existing genus Varanus. In some respects, the teeth of the Nothetes resemble in miniature those of the great carnivorous Megalosaurus of the Stonesfield oolite and the Tilgate grit. This specimen is from the collection of Mr. Willcox, and was obtained from the limestone-bed with chert, numbered 84 in the Catalogue of the Purbeck beds, published by the Rev. J. H. Austen, in his *Guide to the Geology of the Isle of Purbeck, &c.*—2. *Macellodus Brodiei* (Owen). Several specimens in Mr. Brodie's collection from the "dirt-bed" with fresh-water shells, No. 86, in the published Catalogue above referred to, contain fragments of jaws with teeth, part of a vertebra, scutes, and other remains of a small reptile, the teeth of which have some similarity of form to those of the great Hylæosaurus of the Wealden, and still more to those of the Cardiodon, of the Forest Marble, and the *Palæosaurus platyodon* of the Durdham Down conglomerate. 3. *Spalacotherium tricuspidens* (Owen). Mr. Brodie's specimens from the same bed, No. 86, contained also several parts of small jaws with teeth, which Professor Owen, after clearing away the matrix, recognised as belonging to a small mammalian animal of the Insectivorous class. The peculiar modification (the Professor observed) of the pointed cusps of these teeth, as to number, proportion, and relative position, resembles in some degree that of the Cape mole (*Chrysoclora aurea*), but the number of the molar teeth themselves, at least *ten* in each ramus of the lower jaw, accords more closely with that in the extinct Thylacotherium, of the Stonesfield oolite, than with any of the existing types of insectivorous dentition. These newly-discovered forms, the reptiles as well as the mammal, are regarded by Professor Owen to have been decidedly insectivorous; and, in the conclusion of his paper, the Professor dwelt upon the fact of the great abundance of insect life existing in the Purbeck period, as evidenced by the innumerable specimens discovered by the Rev. Messrs. Brodie, Fisher, and others, in the Purbeck beds of Dorset and Wilts, and described by Mr. J. O. Westwood, at a recent meeting of the Society.

THE SUBMARINE FOREST OF LEASOWE.

MR. J. CUNNINGHAM has described this phenomenon to the British Association. The occurrence of trunks and roots of large trees beneath low-water mark had induced the belief that a subsidence had taken place of the shores at Leasowe and Formby, and at

the estuary of the Mersey, amounting to several feet within the last thirty years. Such subsidence, it was argued, could not have been caused by any deeply-seated subterranean action, because the rocks at New Brighton, and Hilbre Island, and Hilbre Point—the latter close to the submarine forest—would have manifested some sympathy with the area under the depressing influence, whereas their elevation had been unchanged for centuries. The author had caused two borings to be made: the first gave, sand 2 feet; peat, with trunks of trees, 4 feet; red clay, 16 feet; quicksand, penetrated to the depth of 4 feet only. The second boring was commenced outside the embankment, 8 feet below the level of the marsh; and gave red clay, 10 feet; brown clay with sand-beds 2 or 3 inches thick, and 5 or 7 feet apart, penetrated to the depth of 38 feet. Mr. Cunningham supposed that the abrading action of the tides on the edges of these strata would prepare a ready means of escape for the water and sand underneath the clay, during the refluxes of the tide; and that the hydrostatic pressure of water at a higher level in the permeable strata, would force the sand from underneath the clay beds, and cause the shore to subside. The clay and peat would resist the action of the water longer, and descend conformably with the undermining of the lower strata until submerged even beneath the level of low water. In Bidston Marsh, which formed a continuation of the flat shore at Leasowe, there were also the remains of an ancient forest imbedded in peat; but in the south-east corner of the marsh trees still flourished at a level only 18 inches above that of the extinct forest. Professor Harkness stated, that the moss at Formby was interstratified with silt, showing that the sea had sometimes gained access, and at others been shut out; the bitumen of Ormskirk really came from these peat-bogs at Formby. Sir C. Lyell remarked, that the action of water on clays was much more rapid than on root-beds.—*Athenæum*, No. 1408.

NEW FOSSILS.

THE following new Fossils have been illustrated and described to the Meeting of the British Association, at Liverpool:—

Mr. Charlesworth exhibited and described several new vertebrate fossils:—1. Vertebræ, supposed to be cetacean, from upper greensand of Cambridge, in the cabinets of the Rev. T. Image and Mr. Reed, of York. Their structure was extremely dense, and the ends marked with radiating grooves as in Mammalian Vertebræ, which have lost their epiphyses. The bodies of these Vertebræ were depressed, giving an elliptical section, and on the dorsal surface was a ridge instead of the usual spinal canal. The vascular foramina were large.—2. Part of the lower jaw of a new mammal (*Stereognathus ooliticus*, (Ch.) from the Stonesfield slate, in the cabinet of the Rev. J. Dennis, of Bury. This was the fifth quadruped of the Stonesfield slate, and must have been twice the size of any of the others. The specimen was part of the centre of one division of the lower jaw; its curvature was very slight, and the concavity below. The section, where it was broken across, was rectangular, and as

wide as deep. The surface presented no traces of sutures or vascular lines. Three teeth remained, occupying half the length of the fragment, and one of these had six similar cusps arranged in two rows. —3. The skull of a new mammal, named *Platychœrops Richardsonii* (Ch.) from the London clay of Herne Bay; about the size of the Hyracotherium, but quite distinct, having very prominent zygomatic processes, and the crowns of the molar teeth being furnished with one large tubercle occupying two-thirds of the surface, and several small complicated tubercles inside.—4. *Teleosaurus ischnodon,* (Ch.) a new species, in the Museum of the Yorkshire Philosophical Society, with teeth very closely crowded, leaving only a slender bony partition between the sockets.

Sir R. I. Murchison exhibited a slab of *Old Red Sandstone* sent by the Rev. T. T. Lewis,—one of the greatest contributors to the elucidation of Siluria, who had lately discovered rippled surfaces and trails of animals in the Old Red Sandstone of Puddlestone, near Leominster. The tracks were of two kinds, one set perhaps produced by a mollusc, the other by a crustacean.

Professor Buckman communicated a notice of two *Elephants' Tusks* found in the Stroud Valley, Gloucester. The largest was slightly curved, 10 feet long, 3 feet in circumference, and 1 foot 6 inches in its greatest diameter; the other tusk was curved, forming three-fourths of a circle. Remains of rhinoceros and hippopotamus were found in the same gravel.

A Pterichthys from the Old Red Sandstone of Moray, has been described to the Geological Society, by Capt. L. Brickenden. This is a new species of Pterichthys, remarkable for its great size (20 inches long and 6 broad), and its peculiarly ornamented surface. The paper was illustrated by drawings, in which the author had restored the whole of the external bony armour and defences of the fish from the numerous characteristic fragments that he had obtained, chiefly from the Vale of Rothes.

Old Red Sandstone.—An important discovery has been made in the Lower Old Red Sandstone beds of Wick and Thurso, by Mr. Peach, the well-known naturalist and zoologist. Fossil wood and shells, the existence of which in Caithness was hitherto unknown, have been abundantly found *in situ;* the former at Thurso, and both wood and shells at Wick and in the vicinity; the shells having undergone considerable abrasion. These facts will, doubtless, give new life to the explorers of the Old Red Sandstone formation, bestowing, as they do, positive evidence of what has formerly been considered at best but doubtful—the existence of vegetable organisms *of the land* at the Old Red period.—*John O'Groat's Journal.*

Trees.—An immense fossil tree has been discovered in the Bromfield Freestone Quarry, Airdrie, when only thirty-six feet were uncovered, and from the thickness at which it disappeared in the adjacent rock, its entire length seemed greatly to exceed fifty feet. The roots showed a diameter of not less than six feet; the base of it runs to fully two feet in diameter. The depth at which it was found is fully thirty-nine feet.—*Glasgow Chronicle.*

A portion of the stem of a fossil tree has been found at the bottom of the well recently sunk near the new hall of Mr. J. Crossley, on Skircoat Moor, and has been presented to the Halifax Literary and Philosophical Society. It has the appearance of a *Sigillaria;* but the marks upon it are so different from those ordinarily borne by that extinct genus as to indicate almost another generic character. Instead of being round or only slightly oval, they are small oblong pits with but little breadth; it is to be regretted that more of the tree could not be extracted, in order that it might have been ascertained whether this peculiarity extended further up the stem.—*Halifax Guardian.*

COPROLITES IN EAST SUFFOLK.

THE immense quantities of Coprolite and rough stone found on the shore of Bawdsey to Boyton, and the intermediate parishes verging towards Woodbridge, are incredible. In one cottager's garden, 20*l.* worth has been obtained, and many other persons have been equally fortunate.—*Essex Standard.*

MINERAL CHARCOAL.

THIS substance occurs in a black, pulverulent, silky-looking form, or a granular powder, in almost all descriptions of coal, but is most abundant in those beds which appear to have resulted partially from drifting; in Nova Scotia as well as in Great Britain. At Sanquhar, the culmstone coal, which has a roof of fine indurated clay, indicating tranquil water, contains little Mineral Charcoal, whilst in the "Creepy coal," which has a flaggy roof, the charcoal is abundant. Microscopically examined, the charcoal appears to consist of cellular or glandular tissues; the fibrous parts especially resemble the texture of the Cala-modendra of the Lancashire coal-measures.—*Mr. Harkness; Proceedings of the British Association.*

THE COAL FIELDS OF THE WORLD.

THE following information as to the great Coal Fields of the World is given in *Herapath's Journal*:—The United States contain 129,230 square miles of coal; Great Britain contains 11,850; Spain, 3408: France, 1719; and Belgium, 518; but the actual yearly product of coal in different countries was as follows in 1852:—Great Britain, 31,500,000 tons; Belgium, 4,960,000; United States, 4,000,000; and France, 4,140,000 tons.

EARTHQUAKE INDICATOR.

M. RATIO-MENTON has communicated to the Paris Academy of Sciences, a sure means of learning the approach of an Earthquake. According to this gentleman, the Earthquake Indicator is nothing more than a magnet, to which is suspended, by magnetic attraction, a little fragment of iron. Shortly before the occurrence of an earthquake, the magnet temporarily loses its power, and hence the iron *falls.* According to M. Ratio-Menton, the accuracy of this indicative sign has been thoroughly tested by a highly-educated Argentine

officer, Colonel Epinosa, during a residence of many years at Arequipa, a region where earthquakes are very frequent. Independently of the authority of the communication, arising from the respectability of the communicator, and from its being published in the *Transactions of the French Academy of Sciences*, the result is nothing more than might have been suspected, from theoretical considerations of the alliance between electricity and magnetism. A disturbance of electric power has long been known to be associated with earthquakes.—*Jameson's Journal*, No. 114.

THEORY OF EARTHQUAKES.

A Report of the Committee of the Institute of France, consisting of MM. Lionville, Lamé, and Elie de Beaumont, on the subject of the Theory of Earthquakes, has been transmitted for the use of the British Association. From a careful discussion of several thousand of these phenomena, which have been recorded between the years 1801 and 1850, and a comparison of the periods at which they occurred with the position of the moon in relation to the earth, the learned Professor, M. Perrey, of Dijon, infers that earthquakes may possibly be the result of an action of attraction exercised by that body on the supposed fluid centre of our globe, somewhat similar to that which she exercises on the waters of the ocean; and the Report of the Committee of the Institute is so far favourable, that at their instance the Institute have granted funds to enable the learned Professor to continue his researches. It will be recollected how often the attention of the Association has been drawn to this subject by the observations of Mr. Milne and of Mr. Mallet, which latter are still going on, and that the accumulating facts are still waiting for a theory to explain them.—*From the Earl of Harrowby's Address to the British Association at Liverpool.*

EARTHQUAKES IN 1854.

France.—On the morning of July 20, at a quarter to three o'clock, at Barèges, an oscillation of the houses, and a rumbling noise very like that produced by a wagon loaded with iron bars in a narrow road, greatly terrified the inhabitants. Three shocks, at intervals of about five minutes, shook the whole chain of the Pyrenees. At the Military Hospital, the loaves of bread laid out on the shelves rolled off, and the muskets fell out of their stands. The walls of this establishment (very old) were completely split up on the inside.

A letter from Nice gives the following details of an earthquake felt there in the night of December 28th:—"For three-quarters of a minute the earth shook with violence, the houses appeared as if they were about to be torn up out of the ground. There were three distinct shocks. The first was the strongest. A number of houses in one street had the walls cracked, and one house in the town has fell down, and another in the neighbourhood."

A slight undulatory shock of earthquake, which lasted about three seconds, was felt at Alessandria on the 29th of Dec.

On the same day, two severe shocks were experienced at Turin, at

about three A. M. They were undulatory, in the direction N.E.–S.W., and preceded and accompanied by a rumbling noise and violent wind. The shocks succeeded close upon each other, and lasted several seconds each.

Central America; San Salvador.—On the night of April 16, (Easter Sunday), this beautiful capital became a heap of ruins. On Thursday morning, movements of the earth were felt, preceded by sounds like the rolling of heavy artillery over pavements, and like distant thunder. On Saturday all was quiet. The heat on Sunday was considerable, but the atmosphere was calm and serene. At half-past nine in the evening, a severe shock of an earthquake, occurring without the usual preliminary noises, alarmed the whole city. At ten minutes to eleven, without premonition of any kind, the earth began to heave and tremble with such fearful force that in ten seconds the entire city was prostrated. The crashing of houses and churches stunned the ears of the terrified inhabitants, while a cloud of dust from the falling ruins enveloped them in darkness. The clock-tower of the cathedral carried a great part of the edifice with it in its fall. The towers of the church of San Francisco crushed the episcopal oratory, and part of the palace. The church of Santo Domingo was buried beneath its towers, and the College of the Assumption was entirely ruined. The new and beautiful edifice of the university was demolished. The church of the Merced separated in the centre, and its walls fell outward to the ground. Of the private houses a few were left standing, but all were rendered uninhabitable. The public edifices of the government and city shared the common destruction. The devastation was effected, as we have said, in the first ten seconds, for, although the succeeding shocks were tremendous, and accompanied by fearful rumblings beneath the feet, they had comparatively trifling results. (*Boletin Extraordinaire del Gobierno de Salvador.*) The whole city, which contained 28,000 persons, was, with the exception of a single building, levelled to the ground. The great shock occurred on Sunday, at noon. Hundreds of the adobe houses were thrown down, filling the air with dust. A private letter states that the destruction of life and property was far more awful than at first represented, nearly five thousand persons having been killed by the catastrophe.

CAUSE OF THE PRIMITIVE INCANDESCENT CONDITION OF THE EARTH AND OTHER PLANETS.

MR. JAMES NASMYTH, in a communication to the Astronomical Society, offers some suggestions in explanation of the above phenomenon, in which he attempts to trace to its source, or assign a cause of the primitive molten condition of the Earth. "I conceive," says Mr. Nasmyth, "that countless ages might elapse, through the mutual action of the agencies I have referred to, ere such a globe had commenced the earliest stages of its geological history, which would date from that period when all further accession of temperature was at an end, and the nucleus (now a planet) began to part with its primitive heat by its radiation into space."

Astronomical and Meteorological Phenomena.

COMET OF BIELA.

A CORRESPONDENT of the *Athenæum* No. 1384, writes: "As a probable assistance to the elaboration of the inquiry, stimulated by some hundreds of ducats (of Holland) prize offered by the St. Petersburgh Academy of Sciences, into the true path of the Biela Comet, especially in reference to its disruption in 1846, two nuclei then being formed of the severed mass, this account is produced of the transitory phenomenon which was witnessed in London at the time when the comet was expected to cross our orbit. The day was clear, and at the precise minute (not kept in memory) about two p.m., a *cloudless gloom* filled all the air—with, as far as might be inferred from a sudden difference of temperature being experienced, a slight fall of the thermometer; the clearing, not quite so simultaneous as the gloom imposed itself from the northern part of the welkin dome, lingered rather on one side of the southern centre. The full accession of sunlight and resumption of the genial tone of the atmosphere speedily followed the removal of the transparent shade by which every part of the visible panorama had been visited. It was at the north end of Gray's Inn Garden where this was observed—when the then fore-calculated passage of Biela was being borne in thought. The idea resulting was that the comet had come on us, diffused past —causing the gloom and check of warmth, and reuniting, its gaseous substance proceeded in its ellipsis. I now infer that its quantity was less than could entirely ensphere this planet, and that its velocity admitted not of the mutual attraction of the disrupted portions ere the greater attraction of cohesion in each necessarily maintained the severance. That these effects should occur, and that no mixture with nor rape of some of our atmosphere should be consequent thereon, may perhaps be better accounted for than by the resistance given to the body of the comet at the confines of attenuated air, were the notion to be entertained that the air is surrounded by a diaphanous defence which possesses a sufficient density and centrifugency to be the preserver of the atmosphere in elasticity, and capable of being its buckler against cometary assaults. The refractions and attraction such exterior orb would demand might enlighten centrally eclipsed Luna, and help the Theory of Tides."

SOLAR SPOTS.

THERE have been read to the British Association some "New Observations on Solar Spots and Fæculas, and their true Causes," by M. Chacornac, communicated by the Abbé Moigno. M. Chacornac considers the solid body of the sun to be surrounded with a luminous envelope extending to a short distance as well as by an atmosphere which at lower parts, or those next to the luminous envelope and

body of the sun, is very dense, detached clouds, or other bodies, floating in this atmosphere when they were light enough to float outside and beyond the luminous envelope, constitute spots, and can be shown to be capable of exhibiting all their usual phenomena, while those which are dense enough to descend into the luminous atmosphere constituted feculæ; those lower still were hidden from view by the brilliancy of the luminous envelope.

Professor Stevelly said that if he correctly understood the views of M. Chacornac as given by the learned Abbé, they were exactly those originally propounded by Sir William Herschel, father to our own Sir John W. F. Herschel.—*Athenæum*, No. 1407.

MEDICAL METEOROLOGY AND ATMOSPHERIC OZONE.

DR. MOFFAT, in a paper read by him to the Meteorological Society, states that since the discovery of ozone in April, 1848, the above subject has engaged his constant attention. From Tables formed from the observations of four years, from 1850 to 1853, he seeks to establish a connexion between Atmospheric Ozone and the Meteorological conditions of the Atmosphere, together with the prevalence of disease and mortality. The chief conclusions at which Dr. Moffat arrives are:—1st. That ozone periods always commence with decreasing readings of the barometer and increase of temperature; and terminate with increasing readings of the barometer and decrease of temperature. 2nd. That as ozone periods commence very frequently with the wind in the south-east, and terminate in the north-west, those points adjacent to the south-east he calls their points of commencement; and those adjacent to the north-west, those of their termination. 3rd. That ozone and cirri always accompany each other, and would appear to be peculiar to the south or equinoctial current. The author, therefore, designates the south points of the compass as those of ozone and cirri; and the north, or polar points, as those of no ozone and no cirri. 4th. That snow and thunder-storms take place generally in the south-east points and during calms; whilst hail and auroræ are peculiar to the north-west points. 5th. That the maximum of disease occurs with the wind in the south points, and the minimum of mortality when in the north points. 6th. That some diseases are peculiar to certain directions of the wind. 7th. That apoplexy, epilepsy, paralysis, and sudden deaths, are very common during hail and snow showers; and when the wind is in the points at which these phenomena generally occur, viz., the north-west and south-east. 8th. That ozone is in greater quantity on the west coast than in inland districts. The author concludes by stating that, owing to the action of light and the influence of atmospheric currents in producing decomposition of the iodide of potassium, it is necessary, in order to secure uniformity of results, to place the test-papers in darkness, and to keep them protected from atmospheric currents.

METEOROLOGY OF 1854.

Results deduced from the Meteorological Register kept at the Royal Observatory, Greenwich, during the year 1854, under the Superintendence of the Astronomer Royal.

Months.	Mean Reading of Barom.	Mean Tension of Vapour.	Mean Pressure of Dry Air.	Temperature of Air. Dry Bulb Therm.	Self-Reg. Therm.	Adopted.	Highest.	Lowest.	Range.	Mean Daily Range.	Temperature of Evap.	Evap. below Air.	Dew Point below Air.	Dew Point.	Rain. No. of Days.	Amount, in Inches.	Weight of Vapour in Cubic ft. of Air.	Mean additional Weight required to saturate a cubic foot of Air.	Mean Degree of Humidity.	Mean Weight of a cubic foot of Air.
	In.	In.	In.	°	°	°	°	°	°	°	°	°	°	°		Ins.	Gr.	Gr.		Gr.
Jan	29·618	·234	29·384	39·0	39·0	39·0	54·8	13·5	41·3	10·8	38·0	1·0	2·9	36·1	15	1·7	2·7	0·3	·917	546
Feb	30·011	·218	29·823	39·2	40·0	39·5	57·0	23·5	33·5	13·6	37·5	2·0	5·9	33·6	9	1·0	2·6	0·5	·843	554
March ..	30·186	·236	29·950	43·5	44·0	43·8	64·2	25·5	38·7	19·2	40·9	2·9	6·4	37·4	6	0·4	2·8	0·7	·795	551
April	29·985	·273	29·712	48·3	48·5	48·4	77·5	28·3	49·2	23·7	45·0	3·4	7·3	41·1	7	0·6	3·1	0·9	·775	542
May	29·667	·328	29·339	50·5	51·0	50·9	70·5	34·8	35·7	21·3	48·6	2·3	5·0	45·9	17	3·3	3·7	0·7	·850	534
June ...	29·735	·371	29·364	55·5	55·8	55·7	78·5	41·4	37·1	19·2	52·7	3·0	5·7	50·0	12	1·0	4·2	0·9	·825	529
July ...	29·807	·413	29·394	60·3	60·2	60·3	88·7	44·0	44·7	21·6	56·2	4·1	6·7	53·6	15	1·7	4·6	1·3	·783	525
Aug	29·889	·416	29·473	60·8	61·1	60·9	85·2	43·0	42·2	20·7	56·5	4·4	7·6	53·3	12	2·9	4·7	1·4	·771	526
Sept ...	30·031	·375	29·656	58·1	58·2	58·1	81·2	37·9	43·3	25·7	53·9	4·2	7·7	50·4	9	0·7	4·3	1·3	·770	532
Oct	29·724	·309	29·415	49·0	49·9	49·4	72·8	31·3	41·5	17·5	47·1	2·3	4·9	44·5	8	2·6	3·6	0·6	·846	536
Nov	29·728	·245	29·483	40·4	40·6	40·5	61·6	25·9	35·7	12·7	39·4	1·1	2·6	37·9	13	1·4	2·9	0·3	·916	547
Dec	29·768	·239	29·529	41·2	41·5	41·3	55·0	26·5	28·5	11·0	39·6	1·7	4·3	37·0	16	1·4	2·8	0·4	·872	546

EXPLANATION.

The cistern of the barometer is about 159 feet above the level of the sea, and its readings are coincident with those of the Royal Society's flint-glass barometer. The observations are taken daily at 9 A.M., noon, 3 P.M., and 9. P.M.; the means of these readings are corrected for diurnal ranges by the application of Mr. Glaisher's corrections, as published in the *Philosophical Transactions*, Part 1. 1848, and from the readings of the dry and wet bulb thermometers, thus corrected. The several hygrometric deductions in columns 3, 15, 18, 19, 20 and 21, are calculated by means of Mr. Glaisher's Hygrometric Tables.

The numbers in column 2 show the mean reading of the barometer every month, or the mean length of the column of mercury which balanced the whole weight of atmosphere of air and water; the numbers in column 3 show the length of a column of mercury balanced by the water mixed with the air alone; and the numbers in column 4 show the length of a column of mercury balanced by the air alone, or that the reading of the barometer which would have been had no vapour been mixed with the air.

[*Concluded on next page.*

The numbers in columns 5 and 6 are determinations of the mean temperature of the air by different instruments and methods—those in column 5 by the readings of a simple thermometer, taken at the times before-mentioned, and those in column 6 by the readings of self-registering thermometers daily. The numbers in column 12 show the true temperature of evaporation, and those in column 15 give the true temperature of the dew point, or that temperature at which the vapour in the air is deposited in the shape of water.

The reading of the barometer was in defect in January, June, and December, was about its average value in July and November, and it was in excess in all the remaining months.

The mean reading of the barometer for the year at the height of 160 feet above the mean level of the sea was 29·848 inches, exceeding the average by 0·082 inches.

The temperature of January exceeded the average of 80 years by 4¼°; February by 1½°; March by 3°; April by 3°; May was in defect by 1¾°; June by 2¼°; July by 1°; August was ½° in excess; September was 2° in excess; October was about its average; November was 2° in defect; and December was 2¼° in excess, according to Mr. Glaisher's determination of the mean temperature of each month.

The mean temperature of the year was 49·°. The mean temperature of evaporation was 46°·3; and that of the dew point was 43°·1. The mean degree of humidity of the air was 83, complete saturation being represented by 100. Rain fell on 137 days; and the amount collected was 18·7 inches, being three-fourths only of the annual fall.

The electricity of the atmosphere has been almost always positive, and generally weak.

In the *Year Book* for 1853, was detailed the severe weather in which the year was ushered in. Till January 6 the average daily temperature was 7° below its average; on the 7th, a period of warm weather set in, and continued till February 9; the average daily excess of temperature was 5° nearly; from February 10 to the 19th, the weather was cold, the deficiency of daily temperature was 3°; on February 20 a warm period set in, and continued till April 21; the average excess of temperature within this period was 4° nearly. From April 22 to July 19, the weather was cold, and the daily defect of temperature was about 3½°. At the beginning of July the weather was bleak and variable, and the temperature was on some days from 7° to 10° in defect; from July 20 to the end of the month the temperature was in excess, on the 25th to the amount of 12°, and for the period a daily excess of 4°; from August 1st to the 18th, the varieties of temperature were considerable and frequent; a few warm days being succeeded by a few cold days, and followed by a few warm days again. On August 17, a generally fine and warm period set in, and continued to October 12, the mean daily excess of temperature was 2½°; from October 12 to October 28, the temperature was in defect to the amount of 3° daily; from October 29 to November 2, it was 5¼° in excess. On November 2, a cold period set in, and continued, with the exception of a few days at the beginning of December, till December 12; the average daily defect of temperature within this period was 2½°; from December 13, the temperature was for a few days together in great excess, then for a few days in defect, and then in excess again; and so with rapid alternations till the end of the year; the average daily temperature from December 13th, was 2¾° in excess; the excess on the 14th, 15th, 22nd, and 25th, exceeded 11° on each day.

Thunder storms were less frequent than usual, and but few were of a marked character. On the 26th October, a man was killed at Jersey in a thunder storm, and the iron nails in his shoes were all drawn out.

The severe weather which set in on April 22, caused very great injury to vegetation generally, and many even hardy plants were killed.

The hay harvest was late, and the crops a poor one generally.

Wheat was in flower about July 2; was cut in Cornwall and Devonshire about August 9; in latitude 52° about the 10th; in latitude 53° about the 13th and 14th: and in latitude 56° about the 26th.

The grain crops were good everywhere, and well got in. Apples and pears were scarce. Turnips were small, from the drought; and potatoes were abundant.

Obituary.

LIST OF PERSONS EMINENT IN SCIENCE OR ART. 1854.

M. J. L. VISCONTI, French architect.
M. GAUDICCHAUD, a distinguished French botanist.
M. BLANQUI, French political economist.
SIR HENRY M. ELLIOT, the Orientalist.
JOHN MARTIN, the historical painter, a man of inventive genius. (See page 122.)
DR. WALLICH, the well-known horticulturist.
ARTHUR AIKIN, many years Secretary to the Society of Arts, and Secretary to the Geological Society, which he assisted in founding.
PROFESSOR JAMESON,* the celebrated mineralogist and naturalist; Editor of the *Edinburgh Philosophical Journal*, commenced by him in 1819, and quoted in the *Arcana of Science*, and the *Year-Book of Facts* as *Jameson's Journal*. "'Professor Jameson,' says a fellow-member of the Senatus who knew him well, 'has for half a century filled a most eminent place among the brightest ornaments of Edinburgh University, and is indeed entitled to be universally recognised as one of the most ardent, and one of the most successful contributors to the advancement of science in this enlightened age.' The truth and accuracy of these expressions can only be fully appreciated by those who compare the state of Natural Science in this country at the time when he began his career, with what it became in his hands within the lapse of less than one generation."—*The Scotsman*.
E. WAKEFIELD, statist.
DR. JOHN E. STOCKS, botanist of India.
P. B. WEBB, botanist of Southern Europe.
COLONEL LANDMANN, Professor of Fortifications at Woolwich.
PISTRUCCI, Italian sculptor.
PROFESSOR HAVER SCHWANTHALER, of Munich, sculptor.
DR. GOLDING BIRD, author of several works on Experimental Philosophy.
M. GAUCI, lithographer.
GEORGE BRETTINGHAM SOWERBY, the well-known naturalist.
DR. STANGER, natural historian and traveller.
EDWARD RIDDLE, mathematician.
GEORGE NEWPORT, naturalist.
WILLIAM LAXTON, civil engineer, who established the *Civil Engineer and Architect's Journal*.
BARON DE LINDENAU, Saxon astronomer.
SAMUEL NIXON, sculptor.
MACEDONIC MELLONI, Italian natural philosopher, distinguished by his researches on Heat.
GENERAL PAIXHANS, engineer.
WILLIAM BROCKEDON, artist and inventor.
M. DE BISCHOFF, German botanist.
M. DE MIRBEL, French naturalist.
COLONEL R. T. MUDGE, mathematical geographer.
W. H. BARTLETT, artist and traveller.
PROFESSOR EDWARD FORBES, the eminent naturalist, at the early age of 39. He had just attained the distinguished position of Regius Professor of Natural History in the University of Edinburgh. It is difficult to estimate the loss to science caused by the removal of Edward Forbes; who, following, like his predecessors Walker and Jameson, in the footsteps of Linnæus, gave promise of raising the science of Natural History to a height nowhere yet reached.

* At the anniversary meeting of the Linnæan Society, the President stated that the past year had been a painfully eventful one to the society. The number of distinguished men who had been removed by death, and more especially during the last few weeks, had been unusually large; including among the fellows the names of Aikin, Jameson, Newport, Stokes, and Wallich; and in the foreign list, those of Fischer de Waldheim, Gaudichaud, Adrian de Jussieu, Reinwardt, St. Hilaire, and Schwœgrichen.

GENERAL INDEX.

THE END.

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